Intravenous Dexamethasone and Perineural Dexamethasone Similarly Prolong the Duration of Analgesia After Supraclavicular Brachial Plexus Block

A Randomized, Triple-Arm, Double-Blind, Placebo-Controlled Trial

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Background and Objectives: Perineural dexamethasone prolongs the duration of single-injection peripheral nerve block when added to the local anesthetic solution. Postulated systemic mechanisms of action along with theoretical safety concerns have prompted the investigation of intravenous dexamethasone as an alternative, with decidedly mixed results. We aimed to confirm that addition of intravenous dexamethasone will prolong the duration of analgesia after single-injection supraclavicular block compared with conventional long-acting local anesthetic alone or in combination with perineural dexamethasone for ambulatory upper extremity surgery.

Methods: Seventy-five patients were randomized to receive supraclavicular block using 30-mL bupivacaine 0.5% alone (Control), with concomitant intravenous dexamethasone 8 mg (DexIV), or with perineural dexamethasone 8 mg (DexP). Duration of analgesia was designated as the primary outcome. To test our hypothesis, the superiority of DexIV was first compared with Control and then with DexP. Motor block duration, pain scores, opioid consumption, opioid-related side effects, patient satisfaction, and block-related complications were also analyzed.

Results: Twenty-five patients per group were analyzed. The duration of analgesia (mean [95% confidence interval]) was prolonged in the DexIV group (25 hours [17.6–23.6]) compared with Control (13.2 hours [11.5–15.0]; P < 0.001) but similar to the DexP group (25 hours [19.5–27.4]; P = 1). The DexIV group experienced longer motor block (30.1 hours) compared with DexP (25.5 hours) and Control (19.7 hours) groups. Both DexIV and DexP had reduced pain scores, reduced postoperative opioid consumption, and improved satisfaction compared with Control.

Conclusions: In a single-injection supraclavicular block with long-acting local anesthetic, the effectiveness of intravenous dexamethasone in prolonging the duration of analgesia seems similar to perineural dexamethasone.


A variety of novel local anesthetic adjuncts have been studied in an attempt to prolong the effects of single-injection peripheral nerve blockade (PNB) often with variable success and unproven safety. Among these adjuncts, dexamethasone has gained considerable interest because it has been shown to prolong significantly the duration of analgesia when applied peripherally in combination with local anesthetics. Although dexamethasone has been used both peripherally and centrally in the setting of chronic pain management for decades, its true mechanism and site of action (ie, local or central) are not fully understood. Indeed, dexamethasone has even been shown to reduce postsurgical pain after a variety of surgical procedures when administered systemically in the absence of any nerve block. Given the theoretical concerns of neurotoxicity associated with locally applied perineural dexamethasone, understanding the site of action for dexamethasone as a local anesthetic adjunct, and the most effective and safe route of administration, is ever more important. As such, several investigators have attempted recently to compare the effects of perineural and systemic dexamethasone on the duration of analgesia after PNB, with decidedly mixed results. Two separate studies found that only perineural dexamethasone, and not intravenous dexamethasone, prolongs the duration of analgesia when used in combination with interscalene block and sciatic block, respectively. By contrast, other studies demonstrated that the effects of perineural and systemic dexamethasone on the duration of analgesia are equivalent in the setting of interscalene block and sciatic block, respectively. Therefore, we aimed to confirm that the administration of systemic dexamethasone in the setting of a long-acting local anesthetic solution prolongs the analgesic duration of a single-injection brachial plexus block compared with long-acting local anesthetic alone or in combination with perineural dexamethasone. Specifically, we hypothesized that the administration of intravenous dexamethasone will prolong the duration of analgesia after single-injection bupivacaine for supraclavicular brachial plexus block compared with bupivacaine alone or in combination with perineural administration of dexamethasone for ambulatory upper extremity surgery.

METHODS

Study Participants

This study received Health Canada (US Food and Drug Administration equivalent) and University Health Network Research Ethics Board (REB) approval. This trial was not prospectively registered on clinicaltrials.gov. Although it is our current internal practice to prospectively register all clinical trials at the time of REB approval, the present study was granted REB approval in June 2011, when trial registration had not yet become our uniform practice. After providing written informed consent, patients scheduled for unilateral upper extremity surgery under a supraclavicular brachial plexus block at the Toronto Western Hospital between April 2013 and June 2014 were enrolled. English-speaking American Society of Anesthesiologists (ASA)
classes I to III patients aged 18 to 80 years with body mass index (BMI) of 35 kg m−2 or less undergoing elective ambulatory forearm or hand surgery were considered eligible to participate in this prospective, randomized, double-blind, parallel-triple-arm, placebo-controlled, superiority clinical trial. Exclusion criteria included inability to provide informed consent; significant cognitive or psychiatric history; pregnancy; diabetes mellitus; clavicular fracture; surgical procedure duration of 180 minutes or longer; severe respiratory disease; chest or shoulder deformities on the operative side; preexisting chronic pain requiring daily use of 30 mg or more of oxycodeone (or equivalent); preexisting neurological deficit or neuropathy in the upper extremities; allergy to local anesthetics or dexamethasone or a component of the multimodal analgesic regimen; and contraindication(s) to peripheral nerve blocks such as local skin infection, coagulopathy, or bleeding diathesis.

Randomization and Blinding
A computer-generated random numbers list was used to randomize consented study participants on a 1:1:1 ratio to receive a supraclavicular block with local anesthetic (30 mL bupivacaine 0.5%) alone in the Control group (Control), with local anesthetic (30 mL bupivacaine 0.5%) in conjunction with intravenous dexamethasone 8 mg (2 mL dexamethasone 0.4%), Dexamethasone Omega Laboratory, Montreal, Quebec, Canada) in the perineural dexamethasone group (DexIV), or combination with perineural dexamethasone 8 mg (2 mL dexamethasone 0.4%, Dexamethasone Omega) in the perineural dexamethasone group (DexP), as illustrated in Table 1. The allocation sequence was generated by a research assistant not involved in study interventions or data collection and was concealed in sealed opaque envelopes. Envelopes were provided to the attending anesthesiologist or directly supervised regional anesthesia fellow assigned to the block procedure room on the day of surgery, who performed all nerve blocks. The intravenous and perineural study solutions were prepared to appear identical by a trained anesthesia assistant according to the protocol in Table 1 and labeled only for use. The patients, anesthesiologists performing blocks, intraoperative anesthesiologists, surgeons, nurses, and research assistants collecting outcome data were blinded as to group allocation.

Supraclavicular Block
Before commencement of the nerve block, standard monitors were applied, intravenous access was secured and supplemental oxygen was administered at 6 to 8 L min−1 via face mask. Procedure sedation was provided intravenously by midazolam 0.03 to 0.04 mg kg−1, as needed. Ultrasound-guided single-injection supraclavicular block was performed using a 6- to 13-MHz 38-mm linear US probe (M-TURBO; SonoSite Inc, Bothell, Washington) placed in a sterile sheath and using the previously described17,18 in-plane technique. After identifying the brachial plexus trunks and/or divisions over the first rib, lateral to the subclavial artery, and following skin infiltration with 1 mL of lidocaine 1%, a sterile 22-gauge blunt Stimuplex needle 50 mm (B. Braun, Bethlehem, Pa) was advanced to the junction of the first rib and subclavian artery. After negative aspiration, the perineural solution was injected in 5-mL aliquots ensuring spread in the corer pocket and distension of the brachial plexus sheath. Concurrently, the corresponding intravenous study solution was infused over 10 minutes.

Block Assessment
After completion of injection of the perineural solution, a blinded research assistant evaluated sensory and motor block onset every 5 minutes up to 30 minutes. The extent of sensory block was assessed in the median, radial, ulnar, and musculocutaneous nerve distributions using a 3-point score of 0 = loss of sensation to light touch, 1 = loss of sensation to pinprick, and 2 = normal sensation. The extent of motor block was also tested in the distribution of the median (thumb opposition), radial (thumb abduction), ulnar (thumb adduction), and musculocutaneous (flexion of the elbow in supination and pronation) nerves using a 3-point scale, where 0 = no movement, 1 = paresis, 2 = normal movement. Block success was defined as the achievement of sensory and motor scores of 0 or less in all 4 nerve distributions within 30 minutes of injection of the perineural solution. At the discretion of the attending block room anesthesiologist, a supplemental terminal branch nerve block (5 mL of lidocaine 2% per nerve, as needed) at the elbow or forearm was administered to patients with a successful block in whom surgical anesthesia (defined as sensory and motor scores = 0 in the distribution of surgery) was not achieved by the time the operating theater was ready to receive them. Patients who received a supplemental terminal branch nerve block were included in all analyses based on the principle of intention to treat. Patients who did not meet criteria for block success at 30 minutes were excluded from the data analyses.

Intraoperative Care
An anesthesiologist blinded to group allocation administered conscious sedation intraoperatively, titrated to patient comfort using low intravenous doses of midazolam (1–3 mg), fentanyl (1–2 μg kg−1), and/or propofol (25–75 μg kg−1 min−1). In the event of inadequate analgesia during surgery, surgical site infiltration with lidocaine 2% by the surgeon was followed by conversion to general anesthesia as necessary. These patients were included in the analyses based on the principle of intention to treat.

Postoperative Care
Patients were transferred to the postanesthetic care unit (PACU) after surgery. Moderate or severe pain (visual analogue

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<td>Perineural solution</td>
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<td>Intravenous solution</td>
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DexIV indicates intravenous dexamethasone; DexP perineural dexamethasone.
scale \( [\text{VAS}] \geq 4 \) or patient request for additional analgesics in PACU was treated with fentanyl in 25-\( \mu \)g intravenous increments every 5 minutes, as needed, up to 200 \( \mu \)g h\(^{-1}\) administered by blinded PACU nurses. Once oral intake was permitted, patients requiring additional analgesics received acetaminophen (1 g), followed by oxycodone (5 mg), as needed. Nausea and vomiting were treated with dimenhydrinate 25 mg intravenously and/or ondansetron 4 mg intravenously, as required. Patients were discharged home when they met institutional discharge criteria. Discharged patients received a prescription for oral Tylenol No. 3 (acetaminophen 300 mg/codeine 30 mg) or Percocet (acetaminophen 325 mg/oxycodone HCl 5 mg) if intolerant to codeine, as needed. On discharge from the hospital, patients were provided with and instructed to complete a standardized postoperative diary\(^{19}\) at home and return to the investigators using a stamped return-addressed envelope. All patients received a telephone call by a blinded research assistant on postoperative day 1 to remind them to complete and return their diary, as well as a telephone call at 2 weeks postoperatively to inquire about block-related complications. Any block-related complications identified were followed until resolution.

### Outcome Measures

Duration of analgesia, defined as time in hours to the first report of postoperative pain at the surgical site, was designated as the primary outcome. Secondary outcomes included (1) duration of motor block, defined as time (in hours) to return to normal (or baseline) motor strength in the operative limb; (2) severity of pain at the surgical site (VAS) at 8 and 24 hours, as well as at 7 and 14 days; (3) cumulative intraoperative opioid consumption (converted to milligrams of intravenous morphine equivalent\(^{20}\)); (4) cumulative postoperative opioid consumption (converted to milligrams of oral morphine equivalent\(^{20}\)) at 24 hours; (5) incidence of postoperative nausea and vomiting during the first 24 hours postoperatively; (6) patient satisfaction with pain relief (expressed as VAS) at 24 hours; and (7) occurrence of any block-related complications, including any new paresthesia (numbness or tingling) or weakness in the operative limb at 2 weeks postoperatively.

### Statistical Analysis

Our hypothesis was that intravenous dexamethasone (DexIV group) prolongs the duration of analgesia compared with conventional long-acting local anesthetic alone (Control group) and that intravenous dexamethasone (DexIV group) prolongs the duration of analgesia compared with perineural dexamethasone (DexP group) after supraclavicular brachial plexus block. We used the sequential testing approach as a serial gatekeeping procedure for this hypothesis testing.\(^{21}\) As such, the duration of analgesia observed in the DexIV group was first tested for superiority over the Control group and then tested for superiority over the DexP group.

The mean duration of sensory block associated with ultrasound-guided supraclavicular block performed with 30 mL bupivacaine 0.5% is reported to be 13.7 ± 1.5 hours.\(^{22}\) In the absence of any published data available at the outset of the present trial, it had been our anecdotal experience that addition of intravenous dexamethasone to PNB can prolong the duration of sensory block by as much as 2-fold. This corresponds to a size effect equivalent to 0.98.

Assuming that intravenous dexamethasone increases the duration of analgesia after supraclavicular block by a size effect of 0.98 compared with long-acting local anesthetic alone, we calculated that 66 patients (22 patients per group) would be required to detect a statistically significant difference between groups with \( \alpha = 0.05 \) and 80% power. Allowing a 10% loss caused by patient dropout or incomplete follow-up, we planned to recruit 25 patients per group or a total of 75 patients for the 3 groups. Based on previously published data,\(^{23}\) we also estimated that this sample size would provide 80% power to detect differences as small as 15% in the duration of analgesia between the DexIV and DexP groups.

We used the SPSS Statistics for Windows (Version 22; IBM, Armonk, NY) to perform the analysis. Our calculations were performed under the assumptions that the 3 study groups were independent, that the parent population from which the data were derived is normally distributed, and that within-group variances are equal. The normality of data distribution was tested using the Shapiro-Wilk test. Except for the exclusion of patients with an unsuccessful block at 30 minutes, all analyses used an intention-to-treat approach, with patients evaluated according to the groups to which they were initially randomized, regardless of the actual treatment they received during the study.

Continuous data are presented as mean (SD) or mean (95% confidence interval [95% CI]), whereas categorical data are presented as numbers or percentages. We used a 1-way analysis of variance combined with post hoc testing using the Tukey test to analyze continuous data. We used a contingency table with either \( \chi^2 \) or Fisher exact test, as appropriate, combined with post hoc testing using the Mann-Whitney test for categorical data. We used the Kruskal-Wallis test combined with post hoc testing using the Mann-Whitney-Wilcoxon test for ordinal data. For time-to-event outcomes, we analyzed data using the Kaplan-Meier survival method and compared groups using the log-rank test, with adjustment for multiple comparisons.

The 2-tailed \( P \) value threshold of statistical significance for the 1-way analysis of variance comparison among groups as well as for the log-rank test was calculated using the Bonferroni correction, and the \( P \) value was set at 0.017. The \( P \) values for repeated measurements of the secondary end points were adjusted using the Bonferroni-Holm step-down correction for repeated comparisons.

### RESULTS

A total of 185 patients were approached to participate in this study; and 75 patients were randomized and completed the study protocol (Control group, \( n = 25 \); DexIV group, \( n = 25 \); and DexP group, \( n = 25 \)). Figure 1 represents the Consolidated Standards of Reporting Trials (CONSORT) flow diagram depicting patient progress through the study phases. Block success was documented in all patients; however, 14 patients (Control, 5; DexIV, 2; DexP, 7) required a supplemental terminal branch nerve block to achieve surgical anesthesia in time for operating theater readiness. Intraoperatively, none of the study patients required local anesthetic supplementation by the surgeon or conversion to general anesthesia. Sensory and motor blockade resolved in all patients within the study period, and none of the patients were censored from the survival analysis. The DexIV group included less ASA I patients, but all other characteristics were similar between the study groups (Table 2).

The duration of analgesia (mean [95% CI]) was significantly prolonged in both the DexIV (25 hours [17.6–23.6]) and DexP (25 hours [19.5–27.4]) groups compared with the Control group (13.2 hours [11.5–15.0]; \( P < 0.001 \)). There was no detectable difference in the duration of analgesia between the DexIV and DexP groups (\( P = 1.0 \)). The Kaplan-Meier survival analysis of the duration of analgesia for the 3 study groups is shown in Figure 2. The log-rank test also suggested prolongation of the duration of analgesia for both the DexIV and DexP groups compared with the
Control ($P < 0.001$) and no detectable difference between the DexIV and DexP groups ($P = 1.0$).

The duration of motor block (mean [95% CI]) was significantly prolonged in both the DexIV (30.1 hours [22.0–24.2]) and DexP (25.5 hours [22.2–26.0]) groups compared with the Control (19.7 hours [13.5–23.0]; $P < 0.001$). In addition, the DexIV group experienced motor block duration that was significantly longer by (4.6 hours [3.7–5.5]; $P < 0.00001$) compared with the DexP group. The Kaplan-Meier survival analysis of the duration of motor block for the 3 study groups is shown in Figure 3. The log-rank test also suggested prolongation of the duration of motor block for both the DexIV and DexP groups compared with the Control ($P < 0.001$), as well as for the DexIV group compared with the DexP group ($P = 0.01$).

Patients in the DexIV and DexP groups reported less pain at 24 hours postoperatively compared with those in the Control ($P < 0.0001$); however, no differences in pain were detected between the DexIV and DexP groups at 24 hours (Fig. 4). The 3 groups had similar pain scores at all the other time points.

Postoperative cumulative opioid consumption was reduced in the DexIV and DexP groups at 24 hours postoperatively compared with that in the Control (Table 3). The 3 groups experienced a similar incidence of postoperative nausea and vomiting (Table 3); however, patients in the DexIV and DexP groups reported higher satisfaction with pain relief compared with the Control group. Finally, none of the patients reported any block-related complications.

**DISCUSSION**

This study confirms that addition of intravenous dexamethasone is an effective alternative to perineural dexamethasone to prolong the duration of single-injection supraclavicular brachial plexus block compared with long-acting local anesthetic alone.

The analgesic effects of dexamethasone as a local anesthetic adjunct have long been investigated; however, the actual site of action and potential systemic effect has only recently been addressed. In a trial of patients undergoing shoulder surgery, Desmet and colleagues recently demonstrated that the analgesic duration of a single-injection interscalene block with ropivacaine 0.5% is similarly prolonged with the addition of 10 mg dexamethasone administered either perineurally or intravenously. Curiously, however, the evaluation of interscalene block success in Desmet’s study was performed postoperatively and was dependent on hand strength rather than any evidence of sensory blockade in the shoulder. Moreover, instead of presenting actual pain scores throughout the study period, these authors only present the proportion of patients who reported verbal rating pain scores of 2 or less compared with higher than 2. The difficulty in interpreting the clinical significance of such data is self-evident because pain scores of 3 and 10 were treated as equivalent in this type of
analysis. Next, Fredrickson and colleagues\textsuperscript{16} compared the addition of 8 or 10 mg of dexamethasone administered either perineurally or intramuscularly with 8 mg of intravenous dexamethasone in a mixed surgical population receiving single-injection sciatic nerve blocks or ankle blocks. Although Fredrickson concluded that intramuscular dexamethasone confers similar analgesic benefits to perineural application, the lack of statistical power and absence of a negative control group further complicate the interpretation of these results. In contrast, Rahangdale and colleagues\textsuperscript{14} recently demonstrated that addition of 8 mg of perineural or intravenous dexamethasone to a single-injection sciatic nerve block with 0.45 mL kg\textsuperscript{-1} bupivacaine 0.5% and epinephrine 1:300,000 did not significantly improve the quality of recovery or opioid consumption compared with local anesthetic

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alone. Unfortunately, however, the relatively large doses of bupivacaine and the influence of epinephrine may have at least partially masked the true effects of the dexamethasone. Last, Kawanshi and colleagues compared the perineural and intravenous routes for 4 mg of dexamethasone in the setting of single-injection interscalene block with 20 mL ropivacaine 0.75%. Although these authors reported that only the perineural route can prolong the analgesic duration of interscalene block, this study lacked adequate statistical power to definitively differentiate outcomes between the 2 experimental groups.

The prolongation of analgesia observed herein with intravenous dexamethasone was also accompanied by a prolongation in motor block duration when compared with perineural dexamethasone. Although previous trials have reported that intravenous dexamethasone and perineural dexamethasone similarly prolong the duration of motor block after PNB, the present study is the first to demonstrate that intravenous dexamethasone extends motor block duration to a greater degree than the perineural application. The clinical importance of this finding is questionable because it may preclude ambulation and delay discharge but may prove valuable for select orthopedic inpatients who require continuous passive motion postoperatively.

The mechanism and site of action by which dexamethasone exerts its analgesic and anesthetic effects remain speculative and have been discussed in detail elsewhere. In brief, locally applied perineural dexamethasone is thought to suppress the excitability of nociceptive C fibres via glucocorticoid receptor changes and changes to ion channel function. The local anesthetic effect may also be prolonged by dexamethasone-induced vasoconstriction. In addition, there is likely a local suppression of inflammatory mediators and subsequent ectopic neural discharges in pain fibres. Similarly, the analgesic effects of systemically administered dexamethasone likely arise from a variety of mechanisms, including peripheral and central anti-inflammatory effects by binding to cellular receptors, modifying gene transcription and protein synthesis, and ultimately inhibiting production of prostaglandins, leukotrienes, and proinflammatory cytokines. Dexamethasone is also believed to suppress the neuropeptide immune response in injured tissue, thus lessening the extent of pain.

There are a number of limitations associated with the present study. First, a number of patients required distal supplementation with lidocaine 2% to hasten block onset because of operating room readiness and patient flow efficiencies. Although it is possible that such supplementation could have influenced early postoperative outcomes, it is improbable that our primary outcome measure was affected. On designing the present study, we were aware of the potential for delayed block onset (relative to our institutional standard of 1:1 lidocaine 2%-bupivacaine 0.5% admixture for surgical anesthesia); however, we believed that it was important to evaluate the effect of dexamethasone in the setting of conventional long-acting local anesthetic alone. Furthermore, the minimum therapeutic dose of intravenous dexamethasone capable of prolonging the duration of analgesia after PNB has not been elucidated. It is therefore possible that the dose of dexamethasone used herein may have been sufficiently large so as to mask the true site of action (ie, local or central). Nonetheless, the current state of evidence supports a dose of 8 mg for the perineural application of dexamethasone. Also, although our trial is adequately powered to detect differences as small as 15% that may exist between the DexIV and DexP groups, a sample size of at least 240 patients (ie, 80 per group) would be required to detect very small (ie, <10%) differences in the duration of analgesia between the DexIV and DexP groups. Our results suggest that intravenous

![FIGURE 4. Box plots of postoperative visual analogue scale (VAS) pain scores in the 3 study groups during the first 2 weeks. *A statistically significant difference between the 3 study groups (F test).](image)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Control (n = 25)</th>
<th>DexIV (n = 25)</th>
<th>DexP (n = 25)</th>
<th>P*</th>
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<tr>
<td>Cumulative intraoperative intravenous morphine equivalent consumption, mg</td>
<td>3.3 (1.2–5.4)</td>
<td>3.9 (1.5–6.2)</td>
<td>4.3 (2.0–6.6)</td>
<td>0.3</td>
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<tr>
<td>Cumulative postoperative oral morphine equivalent consumption at 24 h, mg</td>
<td>22.1 (7.6–36.6)</td>
<td>12.5 (2.4–22.6)</td>
<td>13.3 (1.1–25.5)</td>
<td>0.013</td>
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<tr>
<td>Incidence of postoperative nausea and vomiting during first 24 h</td>
<td>4/25</td>
<td>1/25</td>
<td>1/25</td>
<td>0.35</td>
</tr>
<tr>
<td>Patient satisfaction with pain relief at 24 h on an VAS scale</td>
<td>7.2 (4.6–9.8)</td>
<td>9.0 (8.0–10.0)</td>
<td>9.0 (7.9–10.0)</td>
<td>&lt;0.001</td>
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*P* value for the overall F test is set at 0.05.

Values are expressed as the mean (95% confidence interval) or absolute numbers.

DexIV indicates intravenous dexamethasone; DexP, perineural dexamethasone; VAS, visual analogue scale.
dexamethasone and perineural dexamethasone possess very similar treatment effects in the present context; although investigating superiority is likely futile, seeking to demonstrate noninferiority or even equivalence may be a worthwhile future scholarly endeavor. Finally, the present study was not powered to detect complications of perineural dexamethasone. Bench studies investigating the safety of perineural dexamethasone suggest a dose-dependent adverse effect on peripheral nerves, although a more recent study by Williams and colleagues suggests that the neurotoxicity of a dexamethasone-ropivacaine combination is similar to that of ropivacaine alone. An additional concern includes the possibility of a reduction in blood flow associated with the perineural application of dexamethasone; this may have important implications if perineural dexamethasone is coadministered with epinephrine and/or used in diabetic patients. Many formulations of dexamethasone also contain additives. The dexamethasone sodium phosphate solution used in this study contained benzyl alcohol 1%; although this preservative had once been implicated in transient paraparesis after epidural injection, there is little evidence of harm associated with its perineural use, especially in such a diluted concentration as that used herein. Importantly, previous reports of nerve injury associated with perineural dexamethasone have been attributed to direct needle trauma rather than the drug itself.

CONCLUSIONS

When added to a single-injection supraclavicular brachial plexus block with long-acting local anesthetic, the effectiveness of intravenous dexamethasone in prolonging the duration of analgesia seems similar to perineural dexamethasone. Comparable effectiveness and theoretical safety concerns support the use of intravenous dexamethasone over perineural dexamethasone in settings where prolonged analgesia after single-injection PNB is desired.

REFERENCES


7. Candido KD, Knezevic NN. All adjuvants to local anesthetics were not created equal: animal data evaluating neurotoxicity, thermal hyperalgesia, and relevance to human application. Reg Anesth Pain Med. 2011;36:211–212.


