Comparative study on the efficacy of perineural vs intravenous dexamethasone as an adjunct to bupivacaine to prolong analgesia after axillary brachial plexus block in a tertiary care center, Pokhara

Thaneshwor Pahari*, Rozeeta Hirachan¹, Sandeep Neupane¹, Kushal Mohan Bhattarai¹, Praynal Pakhrin¹

¹Department of Anesthesiology, Gandaki Medical College Teaching Hospital and Research Center, Pokhara, Nepal

ABSTRACT

Introduction: In resource-limited settings, adjuvant drugs offer an alternative to extend peripheral nerve block analgesia. This study compared perineural and intravenous dexamethasone for post-operative analgesia in upper limb surgery patients under axillary brachial plexus block. Methods: An experimental study was done on 60 patients undergoing unilateral upper limb surgery under axillary brachial plexus block, randomized into two groups. Group A received bupivacaine 0.25% 30ml with perineural dexamethasone 8mg, and Group B received the same bupivacaine dose with intravenous dexamethasone 8mg. The duration of analgesia, reported as the time of breakthrough pain at the operative site, was considered the primary outcome. The duration of sensory blockade, VAS scores, and postoperative rescue analgesic consumption were noted. Student’s t-test applied to compare difference in mean between two groups. Results: In 60 patients (30 per group), group A showed a statistically significant longer duration of analgesia (9.67±0.92 hours) than group B (8.89±0.93 hours) (p=0.002, 95% CI 0.31–1.27). VAS scores at 4 and 8 hours postoperatively were significantly lower in group A (1.20±0.85 and 1.97±0.67) than in group B (1.80±0.85 and 2.60±0.72). Group A also had significantly lower rescue analgesic consumption (4.17±9.48 mg) than group B (12.50±17.06 mg) (p=0.023). Conclusions: Perineural dexamethasone significantly prolonged analgesia compared to intravenous dexamethasone in patients undergoing upper limb surgery under ultrasonography-guided axillary brachial plexus block.

Keywords: Axillary brachial plexus block, bupivacaine, dexamethasone, perineural.

INTRODUCTION

Pain, defined as “an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage” is a significant consideration in the expanded role of anaesthesiologists.¹ Brachial plexus block has become a preferred choice for upper limb surgeries, not only ensuring effective surgical anaesthesia but also providing postoperative pain management. However, the duration of analgesia from single-shot techniques using local anaesthetics pose a limitation. Adjuncts like dexamethasone offer a valuable option to extend sensory blockade. While studies elsewhere compare perineural and intravenous routes for dexamethasone administration, our institution lacks such data.² The majority of studies that compare perineural and intravenous dexamethasone have focused on various nerve block techniques and anatomical locations, with limited specific emphasis on axillary brachial plexus blocks. Given the unique anatomical considerations and clinical implications of this particular block, it is imperative to ascertain whether the purported benefits of perineural dexamethasone translate uniformly across different nerve block...
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psychiatric history, diabetes mellitus, pre-existing chronic
informed consent, patients with a significant cognitive or
implications, thereby informing evidence-based practice
and improving patient care.

METHODS
This is a single-blinded quantitative experimental study
conducted in Gandaki Medical College Teaching Hospital
from August 2022 to September 2023. After obtaining
clearance from the Institutional Review Committee of
Gandaki Medical College (Ref. No. 251/079/080), 60
patients undergoing unilateral upper limb surgery under
axillary brachial plexus block at Gandaki Medical College
Teaching Hospital were enrolled in the study. The sample
size was calculated using the formula for a two-sample
t-test with mean and standard deviation values taken from
the research done by Abdallah et al.2 The inclusion criteria
encompassed American Society of Anaesthesiologists
Physical Status (ASA-PS) I & II patients aged between 20
and 60 years undergoing unilateral upper limb surgery
under axillary brachial plexus block, weighing more than
40 kg, with a body mass index (BMI) between 20 to 29 kg/
m². Exclusion criteria included patients unable to provide
informed consent, patients with a significant cognitive or
psychiatric history, diabetes mellitus, pre-existing chronic
pain, pre-existing neurological deficit or neuropathy in
the upper extremities, allergy to local anaesthetics
or dexamethasone, local skin infection, coagulopathy,
bleeding diathesis, and intraoperative use of greater than
30ml of inj. bupivacaine 0.25% and supplemental analgesic
administration.

Upon obtaining informed written consent regarding the
patients' participation in the study, a detailed pre-anesthetic
evaluation was performed. Patient identity and the nature
of the operation were confirmed, intravenous (i.v.) access
with an 18G cannula was established, a bupivacaine skin
sensitivity test was conducted, and Ringers Lactate 500ml
was started intravenously. Continuous electrocardiography,
pulse oximetry, and non-invasive blood pressure monitoring
were conducted until the patient was transferred out of the
operation theatre.

Patients were randomized into two groups, Group A and
Group B, using a sealed envelope method. Axillary brachial
plexus block was performed under ultrasonography
guidance using a 3-12 MHz linear ultrasound probe of the
Alpinion E-CUBE 5 ultrasound machine and a 21G x 4”
Stimuplex insulated nerve block needle with 30ml of 0.25%
inj. bupivacaine. Patients in group A received Injection
Dexamethasone 8mg (2ml) perineurally during the axillary
brachial plexus block, while patients in group B received
an equal dose and volume of Injection Dexamethasone
intravenously.

After the completion of the block, an assessment of the
sensory and motor block was performed every five minutes.
The extent of the sensory block was evaluated in the median,
radial, ulnar, and musculocutaneous nerve distributions
using a 3-point score: 0 = loss of sensation to light touch,
1 = loss of sensation to pinprick, and 2 = normal sensation.
The extent of motor block was 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. Surgery commenced when sensory and motor
scores of 1 or less were achieved in all 4 nerve distributions
within 30 minutes of block administration.

The duration of analgesia was recorded as the time in hours
to the first report of postoperative pain at the surgical
site. The degree of sensory block was assessed at 0, 2, 4,
8, and 12 hours postoperatively using the 3-point score
mentioned above. Visual Analogue Scale (VAS) scores were
also assessed at 0, 2, 4, 8, and 12 hours postoperatively.
VAS for grading of pain was done with two end points
representing no pain and worst possible pain, where 0=no
pain, 1–3=mild, 4–6=moderate and 7–10=severe pain.3
Rescue analgesics were administered upon patient request
for supplemental analgesia or if the VAS score was greater
than 4.

The primary outcome was the duration of analgesia reported
as the time of breakthrough pain at the operative site.
Secondary outcomes measured were the degree of sensory
blockade at 0, 2, 4, 6, 8, and 12 hours postoperatively, VAS
scores at 0, 2, 4, 6, 8, and 12 hours postoperatively, and the
total amount of rescue analgesics used within 12 hours
postoperatively. Statistical analysis was performed with

Efficacy of perineural vs intravenous dexamethasone
Daycare tonsillectomy: A safe outpatient surgery

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statistical package for social science (SPSS) was used to interpret the collected data. Student's T-test was used to test for a significant difference in the duration of analgesia, degree of sensory block, VAS score, and total rescue analgesic use within 12 hours between the two groups. The p values of <0.05 was taken to be statistically significant.

RESULTS

A total of 60 patients participated in this study, with 30 patients in each group (Group A: n=30; Group B: n=30). Demographic parameters such as age, gender, weight, and body mass index between the two groups are presented in Table 1.

Table 1: Demographic details of the study participants (N=60)

<table>
<thead>
<tr>
<th>Perineural Dexamethasone (n=30)</th>
<th>Intravenous Dexamethasone (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>42.03±11.31</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>18/12</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>63.10±8.29</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.06±1.70</td>
</tr>
</tbody>
</table>

The duration of analgesia in Group A was found to be 9.67 (0.92) hours, whereas in Group B, it was 8.89 (0.93) hours as demonstrated in Figure 1, showing a statistically significant difference (p=0.002) (95% CI 0.31–1.27).

Figure 1: Graph showing duration of analgesia in both groups

Among the secondary outcomes observed in the study, VAS Scores at 0 and 2 hours postoperatively were 0(0.0) in both Group A and Group B. There was a difference in VAS scores at 4, 8, and 12 hours postoperatively, with VAS scores in Group A being 0.03(0.18), 1.20(0.85), and 1.97(0.67), and in Group B being 0.17(0.46), 1.80(0.85), and 2.60(0.72), respectively, at 4, 8, and 12 hours as shown in Figure 2. VAS scores at four hours postoperatively were not statistically significant (p=0.14), whereas VAS scores at 8 (p=0.008) and 12 hours (p=0.001) post-operatively were statistically significant.

Figure 2: Graph showing VAS scores post-operatively

The degree of sensory blockade in both Group A and Group B was 0(0.0) at 0 and 2 hours post-operatively. Sensory blockade at 4 and 8 hours postoperatively was found to be 0.10(0.31), 1.57(0.50) in Group A, and 0.27(0.45), 1.33(0.48) in Group B, which were not statistically significant (4 hours (p=0.98), 8 hours (p=0.71)). The degree of sensory blockade at 12 hours postoperatively was found to be 1.60(0.49) in Group A and 1.93(0.25) in Group B, respectively, which was statistically significant. (p=0.002)

The amount of rescue analgesics consumed was 4.17(9.48) mg in Group A and 12.50(17.06) mg in Group B within the study duration, showing statistical significance (p=0.023) as shown in Figure 3.

Figure 3: Graph showing amount of rescue analgesic consumed between two groups

Table 2: Comparison between perineural and intravenous dexamethasone (N=60)

<table>
<thead>
<tr>
<th>Perineural Dexamethasone (n=30)</th>
<th>Intravenous Dexamethasone (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of Analgesia (hours)</td>
<td>9.67±1.92</td>
</tr>
<tr>
<td>Rescue Analgesic Consumed(mg)</td>
<td>4.17±9.48</td>
</tr>
<tr>
<td>Sensory Blockage (0 hours)</td>
<td>0.0±0.0</td>
</tr>
<tr>
<td>Sensory Blockage (2 hours)</td>
<td>0.0±0.0</td>
</tr>
<tr>
<td>Sensory Blockage (4 hours)</td>
<td>0.10±0.305</td>
</tr>
<tr>
<td>Sensory Blockage (8 hours)</td>
<td>1.57±0.504</td>
</tr>
<tr>
<td>Sensory Blockage (12 hours)</td>
<td>1.60±0.498</td>
</tr>
<tr>
<td>VAS (0 hours)</td>
<td>0.0±0.0</td>
</tr>
<tr>
<td>VAS (2 hours)</td>
<td>0.00±0.183</td>
</tr>
<tr>
<td>VAS (4 hours)</td>
<td>0.03±0.183</td>
</tr>
<tr>
<td>VAS (8 hours)</td>
<td>1.20±0.847</td>
</tr>
<tr>
<td>VAS (12 hours)</td>
<td>1.97±0.669</td>
</tr>
</tbody>
</table>
Efficacy of perineural vs intravenous dexamethasone

No complications were noted in either group intraoperatively or post-operatively throughout the study period. The results of the statistical analysis are summarized in Table 2.

**DISCUSSION**

This study demonstrates that perineural administration of dexamethasone prolongs the duration of postoperative analgesia compared to intravenous administration of dexamethasone in patients undergoing upper limb surgery under axillary brachial plexus block.

The analgesic effect of dexamethasone has been previously evaluated and demonstrated. The mechanism and site of action by which glucocorticoids exert their effects remain unknown. Perineurally administered dexamethasone is believed to exert its effect through direct inhibition of signal transmission in nociceptive C-fibres, local anti-inflammatory effects, and locally induced vasoconstriction, thus extending the local anaesthetic effect.

In a multicentre randomized trial, it was concluded that perineural dexamethasone provided a longer duration of motor block, sensory block, and postoperative analgesia. However, no intergroup differences were observed (p>0.05) in a comparison between intravenous and perineural dexamethasone for ultrasound-guided Infraclavicular brachial plexus block. 5

Kawanishi et al. compared the perineural and intravenous routes for 4 mg of dexamethasone in a single injection interscalene block with 20 ml ropivacaine 0.75%. Although these authors reported that only the perineural route prolonged the analgesic duration of the interscalene block, this study lacked adequate statistical power to definitively differentiate outcomes between the two experimental groups.

Abdallah et al. conducted a study where 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). The study found that intravenous dexamethasone was equally effective in prolonging the duration of analgesia compared to perineural dexamethasone. 2

Veena et al. conducted a study on 68 patients with ultrasound-guided ICBP block, randomly allocating them into two groups (34 each) to compare the analgesic efficacy of perineural and intravenous dexamethasone as an adjuvant to levobupivacaine. Similar to our results, they found that perineural dexamethasone significantly reduced pain intensity and the need for rescue analgesia in the postoperative period compared with intravenous dexamethasone. 7

A systematic review and meta-analysis conducted by Tan et al. on the efficacy of perineural versus intravenous dexamethasone in prolonging the duration of analgesia with peripheral nerve blocks reviewed fifteen randomized controlled trials (1,467 cases; 738 perineural dexamethasone, 729 intravenous dexamethasone). They concluded that perineural dexamethasone exhibited greater efficacy in prolonging the analgesic duration of peripheral nerve blocks compared to intravenous dexamethasone. 8

Another systematic review and meta-analysis of randomized controlled trials by Zhao et al. on perineural versus intravenous dexamethasone for brachial plexus block reviewed twelve RCTs with a total of 1,345 subjects. They found that perineural dexamethasone prolonged the duration of analgesia, motor block, and sensory block in the main analysis with a significant difference compared to IV dexamethasone. However, in the absence of epinephrine, there were no significant differences between perineural dexamethasone and IV dexamethasone. 9

Several limitations are associated with this study. Firstly, a limited number of cases were enrolled (30 in each group). The study was also conducted for a brief period and did not follow up on the duration of sensory blockade beyond the 12-hour observation period. Furthermore, this study did not observe or follow up on any complications that may be associated with the perineural use of dexamethasone.

**CONCLUSIONS**

The findings from this study showed that administering dexamethasone 8mg perineurally significantly extends the duration of analgesia compared to administering dexamethasone 8mg intravenously during ultrasonography-guided axillary brachial plexus block with 0.25% bupivacaine.

**ACKNOWLEDGEMENT**

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CONFLICTS OF INTEREST: None declared

SOURCE OF FUNDING: None

AUTHORS’ CONTRIBUTION

TP led the study design, coordinated the research efforts, and performed the procedures. KMB and PP were responsible for data collection. TP, RH, and PP conducted data analysis and interpretation. The compilation of reports and preparation of the initial manuscript draft was carried out by TP and SN. All authors, including TP, RH, SN, KMB, and PP contributed to the revision and preparation of the final manuscript draft.

REFERENCES


