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Research Article

Evaluation of the Efficacy of Two Different Doses of Dexamethasone as an Adjuvant To 0.5% Levobupivacaine in Ultrasonic Guided Supraclavicular Brachial Plexus Block

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ABSTRACT

Background: Dexamethasone is frequently used as an adjuvant to local anesthetics to extend peripheral nerve block analgesia; however, the appropriate perineural dose when paired with 0.5% levobupivacaine for ultrasound-guided supraclavicular brachial plexus block (SCBPB) is unknown.
Objective: The purpose of this study was to assess the analgesic efficacy and block characteristics of two different dosages of perineural dexamethasone (4 mg vs 8 mg) combined with 0.5% levobupivacaine in ultrasound-guided SCBP.
Methods: In this prospective, randomized, double-blind trial conducted at a tertiary care institution, 80 adult patients undergoing elective upper limb surgery were randomly assigned to receive 30 mL of 0.5% levobupivacaine with dexamethasone 4 mg (Group A, n=40) or dexamethasone 8 mg (Group B, n=40). The main outcome was the length of sensory blackout. Secondary outcomes were onset time, duration of motor block, time to first rescue analgesia, postoperative VAS scores for up to 24 hours, and adverse events.
Results: The length of sensory block was substantially longer in Group B than in Group A (13.2 ± 1.4 h versus 10.5 ± 1.2 h, $p < 0.001$). Group B had a significantly longer motor block duration (11.5 ± 1.3 h versus 8.9 ± 1.1 h, $p < 0.001$). Group B had a considerably longer wait time to receive their first rescue analgesia (14.4 ± 1.2 h versus 12.0 ± 1.3 h, $p < 0.001$). Group B experienced considerably reduced postoperative VAS scores after 4 hours ($p < 0.05$). No significant adverse events were reported in either group.
Conclusion: When perineural dexamethasone 8 mg is combined with 0.5% levobupivacaine, it considerably prolongs sensory and motor block duration and improves postoperative analgesia compared to 4 mg, while having no additional side effects.

Keywords: *Supraclavicular brachial plexus block, levobupivacaine, dexamethasone, ultrasound guidance, peripheral nerve block, analgesia.*

INTRODUCTION

Ultrasound-guided supraclavicular brachial plexus block (SCBPB) is commonly utilized for upper limb procedures due to its rapid onset, dense anesthesia, and consistent postoperative analgesia. The use of ultrasonic guiding has considerably increased block success rates while decreasing complications including pneumothorax and vascular puncture [1, 2]. Levobupivacaine, the S-enantiomer of bupivacaine, is often used for peripheral nerve blocks because it has a lower cardiotoxicity and neurotoxicity profile than racemic bupivacaine [3]. Despite being a long-acting local anesthetic, single-shot levobupivacaine may not provide adequate postoperative analgesia, necessitating the use of rescue analgesics [4]. Several adjuvants, including clonidine, dexmedetomidine, magnesium, and dexamethasone, have been studied to extend

block duration and improve postoperative pain control [5,6]. Among these, dexamethasone has grown in favor because to its anti-inflammatory effects and ability to extend sensory and motor blockage when delivered perineurally or intravenously [7]. Multiple randomized controlled trials have found that adding dexamethasone to long-acting local anesthetics greatly extends analgesia in brachial plexus blocks [8]. However, the appropriate perineural dose of dexamethasone is still debated. While 4 mg is routinely used, some research suggest that 8 mg may provide a longer block duration while reducing side effects. There is limited data comparing different dosages of dexamethasone, notably 0.5% levobupivacaine, in ultrasound-guided Supraclavicular brachial plexus block. The purpose of this study was to assess and compare the efficacy of 4 mg versus 8 mg dexamethasone as an adjuvant to 0.5% levobupivacaine in ultrasound-guided SCBPB.

MATERIAL AND METHODS

This prospective, randomized, double-blind, parallel-group clinical trial was carried out in a tertiary care center with Institutional Ethics Committee approval. All subjects provided written informed permission before to enrollment. A sample size calculation (alpha 0.05, power 80%) revealed that 36 patients per group were needed to detect a minimum 2-hour difference in sensory block duration (assuming a standard deviation of 2.5 hours). To account for potential dropouts, 40 patients were included in each group, yielding a total sample size of 80. Patients were randomly assigned in a 1:1 ratio to Group A (dexamethasone 4 mg) and Group B (dexamethasone 8 mg) using computer-generated random numbers placed in sealed opaque envelopes. Both the anesthesiologist assessing the outcomes and the patient were unaware of the group allocation.

Inclusion criteria

- Age between 18 and 70 years
- ASA physical status I–III
- Scheduled for elective unilateral upper limb surgery expected to last ≤ 3 hours
- Provided informed consent for Supraclavicular brachial plexus block

Exclusion criteria

- Known allergy to local anesthetics or dexamethasone
- Pre-existing peripheral neuropathy or coagulopathy
- Local infection at the block site
- Poorly controlled diabetes mellitus (HbA1c > 8%) or uncontrolled systemic illness
- Chronic opioid use or long-term corticosteroid therapy
- Inability to understand or use the visual analogue scale (VAS)

Block procedure

Experienced anesthesiologists conducted all supraclavicular brachial plexus blocks preoperatively with ultrasound guidance and a high-frequency linear probe. Standard monitoring (ECG, NIBP, SpO_2) was used, and light sedation with midazolam with or without fentanyl was given as needed. Strict aseptic procedures were followed. Group A received 30 mL of 0.5% levobupivacaine with 4 mg of dexamethasone, whereas Group B received 30 mL of 0.5% levobupivacaine with 8 mg of dexamethasone. The total injectate volume was set to 30 mL in both groups. Following negative aspiration, the local anesthetic solution was administered gradually, focusing on the brachial plexus at the supraclavicular level.

Outcome measures

The primary outcome was the duration of sensory block, which was defined as the period between injection completion and the return of normal sensation or the patient's first request for rescue analgesia. Secondary outcomes included the onset time of sensory and motor block (in minutes), duration of motor block, time to first rescue analgesic (in hours), postoperative pain scores (VAS, 0-10) at 0, 2, 4, 8, 12, and 24 hours, total rescue opioid consumption within 24 hours, patient satisfaction scores, and the incidence of adverse events such as nausea, vomiting, hyperglycemia, infection, or neurological complications.

Rescue analgesia

Rescue analgesia consisted of 1 g of intravenous paracetamol or 50-100 mg of intravenous tramadol, depending on the patient's pain level, and the duration and total dose were recorded.

Statistical analysis

Continuous variables were reported as mean ± standard deviation based on their distribution. Categorical variables were represented as frequencies and percentages. The Student's t-test for regularly distributed continuous variables and categorical variables were evaluated with the chi-square test or Fisher's exact test, if appropriate. Repeated VAS readings were analyzed using two-way repeated measures ANOVA. A p-value < 0.05 indicated statistical significance.

RESULTS

A total of 80 patients were enrolled and randomized equally into two groups, with 40 patients in Group A (Dex 4 mg) and 40 patients in Group B (Dex 8 mg). All randomized patients completed the study and were included in the final analysis. There were no protocol deviations or dropouts during the study period.

Table 1: Baseline demographics and surgical characteristics

Variable	Group A (Dex 4 mg) (n=40)	Group B (Dex 8 mg) (n=40)	P-Value
Age (years)	42.1 ± 9.8	40.3 ± 10.5	0.41
BMI (kg/m²)	24.2 ± 2.9	25.1 ± 3.1	0.28
Male/Female	26/14	24/16	0.64
ASA I/II	22/18	20/20	0.65

Table 2: Block characteristics and analgesic outcomes

Parameter	Group A (Dex 4 mg)	Group B (Dex 8 mg)	P-Value
Onset of Sensory Block (min)	8.5 ± 1.5	7.8 ± 1.2	0.06
Onset of Motor Block (min)	12.0 ± 2.0	11.0 ± 1.8	0.08
Duration of Sensory Block (hrs)	10.5 ± 1.2	13.2 ± 1.4	<0.001
Duration of Motor Block (hrs)	8.9 ± 1.1	11.5 ± 1.3	<0.001

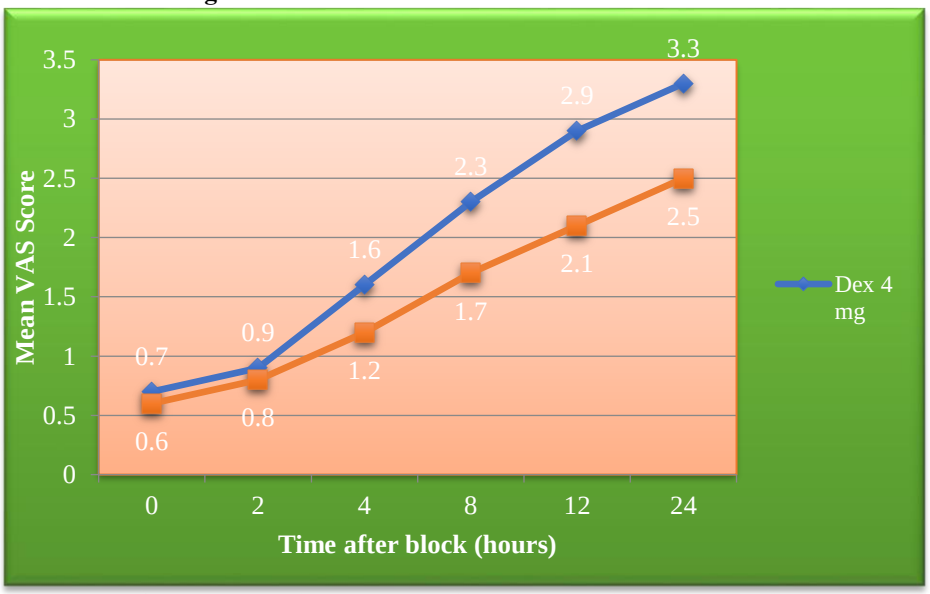
Table 3: Analgesic Outcomes

Outcome	Group A (Dex 4 mg)	Group B (Dex 8 mg)	P-Value
Time to First Rescue Analgesic (hrs)	12.0 ± 1.3	14.4 ± 1.2	<0.001
Total Rescue Analgesic (mg Tramadol equivalent)	110 ± 30	75 ± 25	<0.001
Patient Satisfaction Score (0–10)	7.2 ± 1.1	8.6 ± 0.9	0.002

Table 4: Mean VAS scores over time (0–24 h)

Time (hours)	Group A (Dex 4 mg)	Group B (Dex 8 mg)	P-Value
0 h	0.7 ± 0.3	0.6 ± 0.2	0.31
2 h	0.9 ± 0.4	0.8 ± 0.3	0.27
4 h	1.6 ± 0.5	1.2 ± 0.4	0.01
8 h	2.3 ± 0.6	1.7 ± 0.5	0.003
12 h	2.9 ± 0.7	2.1 ± 0.6	<0.001
24 h	3.3 ± 0.8	2.5 ± 0.7	<0.001

Figure 1: Mean VAS scores over 24 hours



DISCUSSION

The current study shows that when 8 mg perineural dexamethasone is combined with 0.5% levobupivacaine for ultrasound-guided supraclavicular brachial plexus block, it considerably prolongs sensory and motor block duration and delays the

need for rescue analgesia. Previous randomized trials have consistently shown that when long-acting local anesthetics are combined with dexamethasone, the duration of peripheral nerve blocks increases [9, 10]. The process is thought to entail the control of inflammatory mediators, regulation of ectopic neuronal discharge, and possibly vasoconstrictive actions that restrict systemic absorption of local anesthetic. Meta-analyses of dexamethasone as a perineural adjuvant have revealed a dose-dependent extension of analgesia, however the amount of benefit above 4 mg is still contested [11]. Some researchers have documented equal analgesic durations at 4 mg and 8 mg dosages, implying a possible ceiling effect [12]. Other investigations, however, found that greater dosages produced longer-lasting analgesia, notably in brachial plexus blocks [13]. Our findings are consistent with research showing that 8 mg dexamethasone improved postoperative pain scores and delayed the initial analgesic request [14]. The lower VAS values obtained in the higher-dose group after 24 hours indicate improved early postoperative comfort. There have previously been safety concerns expressed about the administration of perineural steroids. However, current clinical trials and systematic reviews have not found substantial neurotoxicity or increased neurological problems at routinely used doses [15]. In our study, no permanent neurological impairments or severe steroid-related problems. The present study's strength rests in its randomized, double-blind design and use of ultrasound guiding, which reduces technical variability. Nonetheless, disadvantages include a single-center design and the lack of long-term follow-up on neurological results. Future multicenter trials with bigger sample sizes are suggested to assess whether 8 mg has a clinically meaningful advantage over 4 mg while maintaining long-term safety.

CONCLUSION

In conclusion, adding 8 mg of perineural dexamethasone to 0.5% levobupivacaine for ultrasound-guided supraclavicular brachial plexus block considerably extends sensory and motor block duration and delays the time to first rescue analgesia when compared to 4 mg. The greater dose also improves early postoperative analgesia while minimizing adverse effects. These data indicate that 8 mg may be a more effective adjuvant dose; nevertheless, larger multicenter trials are needed to determine long-term safety and appropriate dosing.

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