Original Article

Effect of Dexamethasone on Characteristics of Supraclavicular Nerve Block with Bupivacaine and Ropivacaine: A Prospective, Double-blind, Randomized Control Trial

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Abstract

Background: Dexamethasone as an adjuvant to bupivacaine and ropivacaine for supraclavicular brachial plexus (SCBP) block prolongs motor and sensory blockade. However, comparison of effect of dexamethasone (8 mg) when added to these two local anesthetics has not been well studied. This study was conducted to compare analgesic efficacy of dexamethasone as adjuvant to bupivacaine and ropivacaine in SCBP block. Subjects and Methods: Nerve stimulator-guided SCBP block was given to 120 patients, randomly assigned to one of four groups: \((n = 30 \text{ in each group})\) Group B, BD, R, and RD received 30 ml (0.5%) bupivacaine + 2 ml saline, 30 ml (0.5%) bupivacaine + dexamethasone 8 mg, 30 ml (0.5%) ropivacaine + 2 ml saline, and 30 ml (0.5%) ropivacaine + dexamethasone 8 mg, respectively. Time for request of the first rescue analgesic, 24-h analgesic consumption, and different block characteristics were assessed. Student’s \(t\)-test, Chi-square test, ANOVA were used for statistical analysis. Results: Dexamethasone significantly prolonged time for request of the first rescue analgesic of both ropivacaine \((1211.83 \pm 32.86 \text{ vs. } 283.17 \pm 7.71 \text{ min}) \{p \text{ R, RD } < 0.001\}\) and bupivacaine \((1205.17 \pm 34.32 \text{ vs. } 364.67 \pm 16.50 \text{ min}) \{p \text{ B, BD } < 0.001\}\). 24-h requirement for rescue analgesics was more in Groups B and R when compared to Groups BD and RD. The increase in duration of analgesia was more when Groups R and RD \((928.66 \text{ min})\) were compared than Groups B and BD \((840.5 \text{ min})\). Similar results were seen with onset times and duration of sensory and motor block. Conclusion: The addition of dexamethasone to bupivacaine and ropivacaine in SCBP block prolonged time for first rescue analgesia and reduced the requirement of rescue analgesics with faster onset and prolonged duration of sensory and motor block, with the effect being stronger with ropivacaine.

Keywords: Bupivacaine, dexamethasone, ropivacaine, supraclavicular brachial plexus block

Introduction

Postoperative pain causes discomfort to the patient and also impedes the recovery. Relieving postoperative pain is the first duty of anesthesiologist. The analgesic effect of single-shot injection of local anesthetics in supraclavicular brachial plexus (SCBP) block for upper limb surgeries is time limited. Investigators have tried mixing various additives such as epinephrine, clonidine,[1] and opioids[2] but met with limited success and a number of side effects came along such as respiratory depression, hypotension, bradycardia, and sedation. Thus, the search for an adjuvant which significantly prolongs analgesia and has favorable side effect profile continued till some clinicians evaluated glucocorticoids. Dexamethasone being an age old, easily available over the counter, cheap, and safe drug having significant analgesic properties attracts attention. Many studies have shown that dexamethasone as an adjuvant to local anesthetics prolongs motor and sensory blockade in SCBP block. This study was conducted to compare analgesic efficacy of dexamethasone with bupivacaine and ropivacaine in SCBP block.

The primary aim of the present study was to determine whether dexamethasone (8 mg) as adjuvant to bupivacaine and ropivacaine in SCBP block would delay the need for rescue analgesic and reduce the number of analgesics required in the...
first 24 h after surgery and whether the results would differ among the two local anesthetics. Effects on sensory or motor block characteristics were the secondary aims of the study.

**Subjects and Methods**

A randomized prospective study was conducted in a tertiary care hospital from January 2012 to June 2012. After obtaining institutional ethics committee approval and written informed consent, 120 patients of either gender, in the age group of 18–70 years, weight ranging between 50 and 70 kg belonging to American Society of Anesthesiologists Grade 1 and 2 posted for elective surgeries on elbow, forearm, and hand were enrolled for the study. Patients who refused to give informed consent, obese and short-neck patients, patients with coagulopathy, neuropathy, or local infection at the site of block, and those with history of allergy to the study drug or drug abuse were excluded from the study. A detailed history, thorough physical examination, routine investigations, or any special investigations if required were done for the study.

For the purpose of the study, the patients were randomly allocated using computer-generated random number tables into four groups of 30 patients each. Randomization assignments were stored in sealed, sequentially numbered opaque envelopes. The anesthesiologist, who was not involved in the study, opened the envelope in operation theater and prepared the drug accordingly. Observations were done by the anesthesiologist who was blinded to the drug. All blocks were performed by attending anesthesiologist skilled in performing SCBP blocks using peripheral nerve stimulator.

The patient was placed supine on the operation table. Before starting the procedure, all the monitoring equipments (noninvasive blood pressure cuff, pulse oximetry probe, and electrocardiography) were attached to the patient and baseline values of blood pressure, heart rate, oxygen saturation, and respiratory rate were recorded. An intravenous cannula 18G was inserted. No premedication was given. Brachial plexus block was applied using supraclavicular approach and peripheral nerve stimulator. Evoked motor response of forearm or hand muscles was obtained at 0.2–0.4 mA. Once the desirable evoked motor response was obtained, the needle was stabilized and total volume of drug mixture as allocated to four groups was injected slowly after repeated aspiration in divided portions. Group B (30) received 30 mL (0.5%) bupivacaine + 2 mL (0.9%) saline, Group BD (30) received 30 mL (0.5%) bupivacaine + dexamethasone 8 mg (2 mL), Group R (30) received 30 mL (0.5%) ropivacaine + 2 mL (0.9%) saline, and Group RD (30) received 30 mL (0.5%) ropivacaine + dexamethasone 8 mg (2 mL), respectively.

Time of administration of drug was noted [Figure 3]. Patients were evaluated every 5 min after the completion of local anesthetic injection till complete sensory and motor blockade takes place.

Sensory blockade was tested in distribution of medial, lateral, posterior cutaneous nerve of forearm using pinprick method and evaluated using a 3-point score [Table 1]. Onset of sensory block was defined as the time interval between the administration of drug and absence of sensation to pinprick. Duration of sensory block was defined as the time interval between onset of complete sensory blockade to return of normal sensation to pinprick.

Motor blockade was tested by wrist flexion and extension and evaluated using 3-point score [Table 2]. Onset motor block was defined as the time interval between administration of the drug and complete loss of muscle function. Duration of motor block was defined as the time interval between onset of complete motor blockade to recovery of normal muscle function.

The mean onset time and duration of sensory and motor block were noted.

Pain intensity was evaluated using 10 cm visual analog scale (VAS) where 0 represents no pain and 10 represents worst possible pain. Rescue analgesia with intramuscular diclofenac injection 75 mg was given if VAS score was ≥4. VAS score was recorded postoperatively at 0, 5, 6, 12, 20, and 24 h. The time for the first rescue analgesic and 24-h analgesic consumption was noted. Duration of analgesia was defined as the time interval between the onset of complete sensory block to the postoperative VAS score ≥4/time for request for first rescue analgesic.

Blood sugar levels were noted 2 h after injection of drug solution. Throughout the procedure, blood pressure, respiratory rate, and pulse rate were monitored continuously. Vitals signs were recorded at 0, 10, 20, 30, 60 min, 2, 4, 6, 12, and 24 h.

Sample size calculation was based on an initial pilot study involving 10 patients with “time needed for demand of first rescue analgesic” as the primary end point of the study. Time to first analgesic request was 1211 and 283 min in ropivacaine–dexamethasone group and ropivacaine–saline group, respectively, 1205 and 364 min in bupivacaine–dexamethasone group and bupivacaine–saline group, respectively. With α error of 0.05 and power of the study (1– β) at 80%, to detect

| Table 1: Grade of sensory block: 3-point score |
| **SCORE** | **EFFECT** |
| __0__ | No perception of pinprick |
| __1__ | Pinprick felt as sharp pointed sensation but weaker when compared with the same area in the other upper limb |
| __2__ | Normal sensation of pinprick |

| Table 2: Grade of motor block: 3-point score |
| **SCORE** | **EFFECT** |
| __0__ | Absent movement |
| __1__ | Paresis |
| __2__ | Normal muscle function |
a minimum of 1000 min difference in time needed for rescue analgesia between the two Groups B and BD, the sample size was calculated to be approximately 28 in each group. We included thirty patients in each group to compensate for possible dropouts. The patients, who were part of the pilot study, were not included in the study.

The data of the present study were recorded, and after its proper validation, checking for error, coding, and decoding, data were compiled and analyzed using the software SPSS 20 for windows. Appropriate univariate and bivariate analysis was carried out using the Student’s t-test for the continuous variable (age) and Chi-square test for categorical variables. The comparison between four groups was done using ANOVA followed by Bonferroni post hoc test for multiple comparisons. The VAS pain scores were compared using Kruskal–Wallis test, a nonparametric analog of ANOVA. P < 0.05 was considered statistically significant.

**RESULTS**

Demographic data and surgical duration were found to be comparable [Table 3].

Primary outcome is shown in Table 4.

The request for first rescue analgesic was significantly earlier in Group B (364.67 ± 16.50 min) and Group R (283.17 ± 7.71 min) than Group RD (1205.17 ± 34.32 min) and BD (1211.83 ± 32.86 min). Request of first analgesic was earliest in Group R (283.17 ± 7.71 min) and latest in Group RD (1211.83 ± 32.86 min) (p B, BD < 0.0001, P R, RD < 0.0001).

Dexamethasone significantly prolonged duration of analgesia of both ropivacaine (p R, RD < 0.001) and bupivacaine (p B, BD < 0.001). The increase in duration of analgesia was more when Groups R and RD (928.66 min) were compared than Groups B and BD (840.5 min). Moreover, the duration of analgesia was longer in Group B than in Group R. The difference is statistically significant (p B, R < 0.001) [Figure 1].

The median VAS scores of Groups BD and RD were statistically lower than median VAS score of Groups B and R, respectively, at 5th, 6th, 20th, and 24th h postoperatively (P < 0.0001).

At 5 h, median VAS score of all the groups was 0 except Group R, in which median VAS score was 4 and required analgesic at 5th h. At 6th h, Group B had median VAS score 4, hence required analgesic at 6th h. At 20 h, Groups RD and BD also required first dose of analgesic. At 24 h, patients in all the groups had median VAS score >4 [Figure 2].

Dexamethasone significantly lowered the median analgesic consumption for first 24 h in Groups BD (0 [IQR 0–1]) and RD (0 [IQR 0–1]) than in Groups B (3 [IQR 3–4]) and R (3 [IQR 3–4]) (p B, BD < 0.0001, P R, RD < 0.0001).

Secondary outcome is shown in Table 4.

Onset time of sensory and motor block was shorter in Groups BD and RD than in Groups B and R, respectively (p B, BD < 0.001, P R, RD < 0.001). Furthermore, onset time was faster in Group R than Group B (p B, R < 0.001).

Dexamethasone significantly prolonged the duration of sensory and motor block of both ropivacaine (p R, RD < 0.001) and bupivacaine (p B, BD < 0.001). The increase in duration of sensory block was more when Groups R and RD (862.23 min) were compared than Groups B and BD (811.67 min). The increase in duration of motor block was comparable between Groups R and RD (801 min) and Groups B and BD (810.10 min) Moreover, the duration of sensory and motor block was longer in Group B than in Group R (P < 0.001).

### Table 3: Patients’ characteristics and surgical duration

|                | Group B                        | Group BD                       | Group R                        | Group RD                       |
|----------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Age            | 39 ± 5 years months±22 years   | 37 ± 1 year months±16 years    | 33 ± 8 months months±22 years  | 38 ± 6 months months±16 years  |
| Sex (male/female) | 25/5                            | 23/7                           | 25/5                           | 23/7                           |
| Weight (kg)    | 57.5±7.38                      | 58.06±9.97                     | 57.2±7.29                      | 59.0±9.07                      |
| Duration of surgery | 114 min±5 min 5 s               | 107 min±15 min 7 s             | 105 min 38±30 min 25 s         | 117 min 11±39 min 24 s         |

Values are expressed as mean±SD. Group B=30 ml 0.5% bupivacaine + 2 ml saline, Group BD=30 ml 0.5% bupivacaine + 2 ml dexamethasone, Group R=30 ml 0.5% ropivacaine + 2 ml normal saline, Group RD=30 ml 0.5% ropivacaine + 2 ml dexamethasone, SD=Standard deviation

### Table 4: Comparison of quality of block in four groups

|                      | Group B                         | Group BD                       | Group R                         | Group RD                        |
|----------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Time to achieve complete sensory block (min) | 19.13±1.167                    | 15.00±0.695                    | 16.00±1.438                    | 9.27±0.980                     |
| Time to achieve complete motor block (min)  | 24.06±0.907                    | 20.27±1.285                    | 20.27±1.799                    | 14.07±1.929                    |
| Duration of sensory block (min)             | 244.33±11.04                   | 1056±16.90                    | 222.50±8.78                    | 1084.73±11.91                  |
| Duration of motor block (min)               | 199.67±13.32                   | 1009.77±18.56                 | 182.50±10.48                   | 976.00±24.71                   |
| Duration of analgesia (min)/time for request of first rescue analgesia | 364.67±16.50 | 1205.17±34.32 | 283.17±7.71 | 1211.83±32.86 |
| Median first 24-h analgesic consumption (number of diclofenac injection) | 3 (3–4)                      | 0 (0–1)                       | 3 (3–4)                       | 0 (0–1)                       |

Values are expressed as mean±SD. Group B=30 ml 0.5% bupivacaine + 2 ml saline, Group BD=30 ml 0.5% bupivacaine + 2 ml dexamethasone, Group R=30 ml 0.5% ropivacaine + 2 ml normal saline, Group RD=30 ml 0.5% ropivacaine + 2 ml dexamethasone, SD=Standard deviation
No significant difference in mean blood sugar level is seen in any of the groups ($P < 0.05$).

Mean BP in mmHg, mean pulse rate, mean respiratory rate in all the four groups was comparable ($P > 0.05$).

**DISCUSSION**

Regional anesthesia has gained much popularity in outpatient orthopedic surgery. Increasing duration of local anesthetic action is desired for prolongation of postoperative patient comfort, as well as decreasing perioperative opioid consumption and subsequent side effects. Many adjuvants to local anesthetics such as epinephrine, clonidine, tramadol, opioids, dexmedetomidine, and neostigmine have been studied in brachial plexus block, but each drug has its own side effects, and analgesic effect extends only up to early postoperative period. Recently, dexamethasone, a glucocorticoid, when used as an adjuvant to local anesthetics in brachial plexus block has been found to have prolonged postoperative analgesia and a favorable side effect profile.

Dexamethasone is very potent and highly selective and long-acting glucocorticoid; its potency is about 40 times that of hydrocortisone. The mechanism of prolonged regional anesthesia and analgesia produced by corticosteroids is not fully understood. Steroids induce vasoconstriction, thus reduce local anesthetic absorption. Furthermore, they increase the activity of inhibitory potassium channels on nociceptive C-fiber and inhibit synthesis and/or release of various inflammatory mediators. These three mechanisms are known to prolong analgesia. This effect has been proposed to last up to 48 h.$^{[5,6]}$

Many studies reported the prolonged duration of sensory and motor block when dexamethasone was used as an adjuvant with bupivacaine and lignocaine in brachial plexus block, but they differed regarding the onset of sensory and motor block.$^{[7-11]}$

Effect of dexamethasone with bupivacaine and ropivacaine in SCBP block has been studied in interscalene block and it was concluded that the sensory and motor block was prolonged and use of opioid was reduced postoperatively using dexamethasone.$^{[12]}$

In the present study, we observed that adding dexamethasone (8 mg) to bupivacaine and ropivacaine in SCBP block not only delayed the time for the first rescue analgesic but also decreased the number of analgesics required in first 24 h; also, there was early onset of sensory and motor effect and increased duration of sensory and motor block. Hence, our study was in complete agreement with this study except regarding the onset times. In addition, we compared analgesic efficacy of dexamethasone with bupivacaine and ropivacaine and found stronger interaction with ropivacaine. In a study, addition of dexamethasone to a mixture of lidocaine and bupivacaine in SCBP block significantly fastened onset of action and prolonged mean duration of analgesia.$^{[13]}$ Our study was in congruence with their study regarding early onset times and prolonged duration of analgesia. Many studies further substantiated faster onset times of sensory and motor block on addition of dexamethasone to local anesthetic in SBPB.$^{[14-16]}$

No research, till date, has been done for comparing the interaction of two local anesthetics with dexamethasone.

In a study comparing dexamethasone at different doses as an adjuvant to bupivacaine for SCBP block, it was observed that 1 mg and 2 mg of dexamethasone prolonged the sensory and motor block duration to same extent as 4 mg.$^{[17]}$ A meta-analysis concluded that dexamethasone produced late onset of sensory and motor block with prolongation of motor block duration and that the smaller doses of dexamethasone (4–5 mg) were as equally effective as higher doses of dexamethasone (8–10 mg)$^{[18]}$.

In our study, the mean blood sugar levels 2 h after injection of perineural dexamethasone showed no change, which
Hence, it is advisable to establish continuous follow-up for a study. Therefore, late-onset neuropathy could not be detected. The long-term follow-up was not performed in the present to toxicitiy from a single dose of dexamethasone is unlikely. if any, of dexamethasone thus appears to be small. Systemic pain arising from nerve root irritation, safe use in the epidural space for the treatment of radicular this study. In addition, corticosteroids have a long history of preparations – neither of which applies to the formulation of dexamethasone sodium phosphate) used in this study. In addition, corticosteroids have a long history of safe use in the epidural space for the treatment of radicular pain arising from nerve root irritation, and dexamethasone specifically has been studied as an adjuvant to epidural local anesthetics and largely used intravenously for prophylaxis of postoperative nausea and vomiting. The neurologic risk, if any, of dexamethasone thus appears to be small. Systemic toxicity from a single dose of dexamethasone is unlikely. The long-term follow-up was not performed in the present study. Therefore, late-onset neuropathy could not be detected. Hence, it is advisable to establish continuous follow-up for a longer period.

**CONCLUSION**

Dexamethasone (8 mg) when used as an adjuvant to 0.5% bupivacaine and 0.5% ropivacaine for upper extremity surgeries under nerve simulator-guided SCBP block delayed the need of rescue analgesic, decreased requirement for the same in first 24 h, produced faster onset, and prolonged the duration of sensory and motor block. Moreover, stronger interaction of dexamethasone was observed with ropivacaine than bupivacaine.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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