



Original Research Article

Comparison of dexamethasone and dexmedetomidine as adjuvants to bupivacaine in supraclavicular brachial plexus block: A prospective randomized study

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ABSTRACT

Introduction: Supraclavicular brachial plexus block is one of the preferred technique to provide perioperative anaesthesia and analgesia for upper limb surgical procedures. The duration of block can be extended by the addition of various adjuvants. Our aim is to compare the efficacy of dexamethasone and dexmedetomidine as an adjuvant to bupivacaine in extending the duration of supraclavicular brachial plexus block and also to compare the pain scores and postoperative morphine consumption.

Materials and Methods: We randomised 90 patients scheduled for upper limb surgeries into three groups with each group consisting of 30 patients in this prospective randomized study. All patients in the three groups received 25 ml of 0.5% bupivacaine. Along with bupivacaine, Group A patients received 8 mg (2 ml) of Dexamethasone, 1 μ g kg⁻¹ (2ml) of dexmedetomidine in group B and 2 ml of normal saline in group C. Postoperatively, all patients received morphine by patient controlled analgesia (PCA) and the block characteristics, pain scores and total opioid consumption were noted.

Results: We noted a significantly extended motor block (1303.93 \pm 233.71 min vs 888.62 \pm 57.92 min) and extended sensory block (1619.29 \pm 235.49 vs 1084.14 \pm 207.58 min) in dexamethasone group compared with the dexmedetomidine group. The postoperative pain scores and morphine consumption were comparable between the dexamethasone and dexmedetomidine groups.

Conclusion: As an adjuvant to bupivacaine, dexamethasone significantly extends the duration of supraclavicular brachial plexus block compared to dexmedetomidine. Both the above two adjuvants are effective in decreasing the postoperative morphine consumption.

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1. Introduction

Brachial plexus block is being used successfully to provide surgical anaesthesia and analgesia for upper limb surgeries since many years. Single shot supraclavicular brachial plexus block is more popular since continuous technique using catheter is expensive, requires skill with risk of infection.^{1,2} The use of ultrasonography has enabled the procedure of supraclavicular block simpler and safer.^{3,4}

Various drugs have been studied as adjuvants to local anaesthetics in supraclavicular block with an aim to improve the duration and quality of block. Dexmedetomidine is a

potent α_2 agonist with $\alpha_1 : \alpha_2$ ratio of 1600:1, which is 8 times more potent than clonidine.⁵ There are several studies which have proved that, dexmedetomidine as an adjuvant in nerve blocks extends the duration of analgesia.^{6,7} The proposed mechanism is by blocking the hyper-polarisation activated cation current.⁸

Dexamethasone has a potent anti-inflammatory and anti-nociceptive action and various studies have shown its efficacy as an adjuvant in nerve blocks. Studies comparing the above two drugs have shown conflicting results when used as adjuvants in brachial plexus blocks.⁹⁻¹¹ In this research, we aimed to compare the characteristics of block, postoperative pain scores and consumption of morphine with dexamethasone and dexmedetomidine as adjuvant to

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bupivacaine in supraclavicular brachial plexus block.

2. Materials and Methods

We obtained Institutional Ethics Committee approval and written informed consent from all participants. Ninety patients of American Society of Anaesthesiologists (ASA) physical status classification I and II patients posted for hand, wrist, forearm and elbow surgeries between the age group of 18 to 75 years were included in this prospective randomized study. Randomisation was done by computer based block randomisation and allocation by opaque sealed envelope method. The study was completed within 18 months duration.

2.1. Exclusion criteria

Pregnant patients, patients with pre-existing neuropathy of the surgical limb, patients on systemic corticosteroids for two weeks or more within six months of surgery, hypersensitivity to the study drugs and coagulopathy.

All patients received standard premedication according to the department protocol on the night before surgery and the standard fasting guidelines were followed. We explained the procedure to the participants in their own language and informed consent was obtained. In the operating room, standard monitors such as non invasive blood pressure (NIBP), SpO₂ and ECG were attached and the baseline NRS (numerical rating scale) was noted. All patients received i.v. midazolam 0.05 mg/kg⁻¹ before the procedure. We identified the brachial plexus in the supraclavicular region using ultrasound by in-plane technique. Then with the help of a nerve stimulator, using 10 cm stimulating needle, we observed motor response at 1.0 mA intensity at a frequency of 1 Hz. After achieving a twitch, the current intensity was reduced to 0.5 mA and when we observed a continuing twitch at an intensity of less than 0.5 mA, a test dose of 0.5 ml of the study drug was injected. The entire volume of the study drug solution was injected slowly superior and inferior to the brachial plexus after careful negative aspiration.

The study drug solution was administered in all participants as follows.

Group A- 25 ml of 0.5% bupivacaine with 8 mg (2ml) of dexamethasone.

Group B- 25 ml of 0.5% bupivacaine with 1 μg/kg⁻¹ (2ml) of dexmedetomidine

Group C- 25 ml of 0.5% bupivacaine with 2 ml of normal saline.

We kept the total drug volume in all the groups as constant. The patients were assessed for the onset of block every 5 minutes till the first 30 minutes. The onset of sensory and motor block was defined as the time from the injection of drug solution to the time of attainment of grade 1 sensory block and motor block respectively.

The sensory block was evaluated by pin prick method for the entire upper limb innervation which includes the musculocutaneous, radial, ulnar, median, intercostobrachial nerve and the medial cutaneous nerves of arm and forearm. The sensory block was graded as follows.

Grade - 0: Normal sensation (sharp pain felt)

Grade - 1: Blunted sensation (dull sensation or slight heaviness)

Grade - 2: No pain perception

The motor block was evaluated by thumb abduction (radial nerve), thumb adduction (ulnar nerve), thumb apposition (median nerve), flexion of elbow in supination (musculocutaneous nerve) using modified Bromage scale.¹²

Grade - 0: Normal muscle strength with complete flexion and extension of elbow, wrist and fingers.

Grade - 1: Reduced motor strength with weak grip.

Grade - 2: Complete motor blockade with loss of ability to move the fingers.

Fentanyl 1 μg/kg⁻¹ was given as rescue analgesia if patient experienced pain. Even after two such doses of fentanyl, if patient perceived pain, general anaesthesia was administered and the block was considered to be failed. Total amount of intra operative fentanyl requirement was noted. Hemodynamic parameters such as heart rate (HR) and mean arterial pressure (MAP) were recorded. We defined bradycardia as HR less than 60 beats per minute and hypotension as 20% fall in MAP from the baseline. Any event of desaturation with SpO₂ less than 88% was noted.

We defined sensory block as the time interval between the onset of sensory block and the development of pain which requires administration of rescue analgesic in the post operative period. We defined motor block as the time interval between the onset of motor block and the time of attaining modified Bromage grading of zero.

When the patients demanded first dose of rescue analgesic in the post anaesthesia care unit (PACU), the numeric rating scale (NRS) for pain was noted. Immediately patients were put on intravenous patient controlled analgesia (PCA) morphine regimen; bolus of 1 mg with a lockout interval of 10 minutes and no basal infusion. Pain was assessed every four hours for about 24 hours by NRS. Total dose of morphine consumption in each group after the first analgesic request was noted.

2.2. Statistical analysis

We estimated a sample size of 29 in each group, considering a 45 minutes difference in the duration of block with 5% significance level and 80% power. Keeping block failure and drop outs in mind, we approximated the final sample size to 30 in each group.

We used SPSS 19 version for doing statistical analysis. Normality of distribution of data was determined using Kolmogorov-Smirnov tests of normality. Chi square test

was used for analysis of ASA and gender. We expressed age and weight as mean±standard deviation (SD).

Parametric variables like onset and duration of block, fentanyl requirement in the intra operative period and PCA morphine consumption were analysed using one way ANOVA test. Post hoc Bonferroni test was done to compare within the groups. Variables were expressed as mean ± SD.

Kruskal Wallis test was used for the non parametric variables like NRS scores and expressed as median with inter quartile range. We considered p value of <0.05 as significant.

3. Results

Ninety patients were randomised, out of which, 86 patients were studied and analysed. Due to failure of the block, we excluded four patients from the study; 28 in dexamethasone group, 29 in dexmedetomidine and 29 in control groups. With regard to distribution of age, weight, gender and ASA classification, no difference were seen as shown in (Table 1). We observed a comparable onset time of sensory and motor block among the groups ($p>0.05$) as depicted in (Table 2). The mean duration of motor block in Group A was 1303.93 ± 233.71 min, 888.62 ± 57.92 min in Group B, and 503.45 ± 51.98 min in group C. The duration of motor block was significantly extended in group A when compared to group B by 415.31min ($p<0.01$).

The average duration of sensory block as determined by the time to request of first analgesic in the post operative period was 1619.29 ± 235.49 min in Group A, 1084.14 ± 207.58 min in Group B and 646.90 ± 62.39 min in Group C. This shows a significantly extended sensory block in Group A compared to Group B, by 535.14 min ($p<0.01$) and Group C by 972.38 min ($p<0.01$). On comparing group B with group C, we found a significantly extended sensory block in Group B by 437.24 min ($p<0.01$) as seen in (Table 3).

The total consumption of fentanyl in the intra operative period showed no significant difference ($p>0.05$). The first 24 hours PCA morphine consumption was significantly less ($p<0.01$) in Group A (10.32 ± 3.89) and group B (10.83 ± 3.24 mg) when compared to Group C (15.66 ± 4.60 mg) as shown in (Table 4). When we compared Group A and Group B, we did not find any statistically significant difference in PCA morphine consumption ($p>0.05$). NRS scores in the postoperative period did not show any significant difference between the dexamethasone and dexmedetomidine groups. No significant difference in the number of bradycardia and hypotension episodes were observed.

Groups: A-Dexamethasone; B-Dexmedetomidine; C-Control

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* $P<0.01$ between A and B; between B and C and between A and C

* $p<0.01$ between Group B and C; $p=0.86$ between A and C; $p=0.59$ between A and B

Groups: A-Dexamethasone; M-Dexmedetomidine; C-Control

4. Discussion

Supraclavicular brachial plexus block is one of the simple and effective anaesthetic technique for surgeries involving the upper limb. The use of ultrasound has improved the safety profile of supraclavicular block. The addition of various adjuvants to local anaesthetic solution have been extensively studied. In this study, we compared dexamethasone and dexmedetomidine in combination with 0.5% bupivacaine in supraclavicular block for upper limb surgeries. We visualised the brachial plexus with an ultrasound and after confirming motor response with the help of a nerve stimulator, we injected the study drug solution. USG guidance helps in identifying the exact location of the nerve plexus and also in visualising the deposition of local anaesthetic solution at the exact site, thereby avoiding the complications associated with inadvertent needle placement.¹³

Dexamethasone, a long acting glucocorticoid, prolongs the analgesia when given by perineural route in addition with bupivacaine. This may be due to multiple mechanisms such as direct action on glucocorticoid receptors reducing the nociceptive C fibre activity or a local vasoconstriction action reducing the absorption of local anaesthetic or anti inflammatory action by inhibition of the synthesis of inflammatory mediators.¹⁴

Dexmedetomidine, a highly selective α_2 agonist, has been shown to improve the duration of analgesia when added as an adjuvant to bupivacaine in nerve blocks. The analgesic effect of perineural dexmedetomidine is by blockade of the hyper-polarisation activated cation current, as seen in animal study.

Shrestha et al observed significantly faster onset of block with dexamethasone as an adjuvant to local anaesthetic solution in supraclavicular block.¹⁵ Agarwal et al found a faster onset of block when 100 μ g of dexmedetomidine was added with 30 ml of 0.325% bupivacaine in supraclavicular block.⁶ We noted no significant difference in the onset of block between the groups.

In our study, we observed that, both the adjuvant drugs significantly accentuated the duration of sensory and motor block when compared to the control group, though this was significantly more with dexamethasone compared to dexmedetomidine. There are only few studies which have directly compared the above two drugs as adjuvants to local anaesthetic solution in brachial plexus blocks and these

Table 1: Age and weight distribution of patients among the groups

	Group A (n=28) (Mean ± SD)	Group B (n=29) (Mean ± SD)	Group C (n=29) (Mean ± SD)	p value
Age (years)	32.50±10.51	33.31±13.22	34.00 ±13.02	0.90
Weight (kg)	66.82±6.91	67.03±8.54	67.43±7.65	0.60

Table 2: Onset of sensory and motor block

Onset of block (min)	Group A (n=28) (Mean ± SD)	Group B (n=29) (Mean ± SD)	Group C (n=29) (Mean ± SD)	p value
Motor block	15.71±3.78	13.79±3.44	22.07±34.42	0.27
Sensory block	9.11±3.34	8.45±3.01	9.14±3.29	0.69

Table 3: Duration of sensory and motor block

Duration of block (min)	Group A (n=28) (Mean ± SD)	Group B (n=29) (Mean ± SD)	Group C (n=29) (Mean ± SD)	p value
Motor block	1303.93±233.71	888.62±57.92	503.45±51.98	<0.01*
Sensory block	1619.29±235.49	1084.14±207.58	646.90±62.39	<0.01*

Table 4: Opioid requirement

Opioid requirement	Group A (n=28) (Mean ± SD)	Group B (n=29) (Mean ± SD)	Group C (n=29) (Mean ± SD)	p value
Intraoperative Fentanyl requirement (µg)	23.21±39.63	15.52±33.01	25.86±39.23	0.55
Postoperative morphine requirement (mg)	10.32±3.89	10.83±3.24	15.66±4.60	<0.01*

studies yielded diverse findings. Lee et al observed that both dexamethasone and dexmedetomidine were equally effective in prolonging the block as an adjuvant with 0.5% ropivacaine in axillary block.¹⁰ Verma et al observed a prolonged block with dexmedetomidine when compared with dexamethasone as adjuvant with 0.5% ropivacaine in supraclavicular block during elective upper limb surgical procedures.¹¹ Kaur et al compared the effects of 8 mg of dexamethasone with 50 µg of dexmedetomidine as an adjuvant with a mixture of 20 ml of 2% lignocaine with adrenaline and 18 ml of 0.5% bupivacaine in supraclavicular block.¹⁶ They found that dexmedetomidine prolonged the block when compared with dexamethasone. Contrary to these studies, our study showed a significantly prolonged block with dexamethasone.

A significantly less postoperative PCA morphine requirement in the first 24 hours after first analgesic request was seen in the dexamethasone and the dexmedetomidine group compared to the control group in our study. There are no studies which directly compared the postoperative morphine consumption with these two drugs as adjuvants in supraclavicular block. Packiasabapathy SK et al observed significant reduction in postoperative PCA morphine consumption with 2 µg/kg⁻¹ of dexmedetomidine as an adjuvant to bupivacaine in femoral nerve block in patients undergoing total knee replacement arthroplasty.¹⁷ El-Hamid found significantly lesser postoperative morphine

consumption when 8 mg of dexamethasone was added to 0.5% levobupivacaine for inter scalene block in forearm surgeries.¹⁸ In our study, we found that both dexamethasone and dexmedetomidine are equally effective in reducing postoperative morphine consumption when added as adjuvants to bupivacaine in supraclavicular block. Pain assessed by NRS were comparable between the dexamethasone and dexmedetomidine groups. We found no significant difference in the episodes of bradycardia and hypotension between the groups.

There are certain limitations in our study. We did not record the sedation score to study the effect of perineural dexmedetomidine on sedation. Also in our study, PCA morphine was started in the postoperative period once the patient requested analgesics and the total opioid consumption was noted from that time for the next 24 hours. So the total postoperative PCA morphine consumption was for the period of 24 hours from the requisition of first rescue analgesic, and the time of demand differed for individual patients depending upon the duration of sensory block.

5. Conclusion

Dexamethasone as an adjuvant to bupivacaine in supraclavicular brachial plexus block, significantly extends the motor and sensory block duration compared to dexmedetomidine. Both adjuvants reduce postoperative

morphine consumption significantly.

6. Conflict of interest

None.

7. Ethics Committee approval

This study was approved by the Institutional ethics committee, Jawaharlal Institute of Post graduate Medical Education and Research (JIPMER), Puducherry, India.

8. Source of Funding

None.

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