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Dexmedetomidine With Bupivacaine and Dexamethasone with Bupivacaine for Prolongation of Postoperative Analgesia Under Infraclavicular Brachial Plexus Block in Upper Limb Orthopaedic Surgery: A Prospective Comparative Observational Study

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ABSTRACT
Infraclavicular brachial plexus block is used for Upper extremity surgeries. Dexmedetomidine is a highly selective α-2 adrenergic agonist that prolongs the duration of sensory and motor block and provide prolonged postoperative analgesia. Dexamethasone, a long-acting glucocorticoid (t1/2 >36 hrs) has potent anti-inflammatory and analgesic effects and prolongs postoperative analgesia. Hence, the present study was aimed to evaluate the effect of dexamethasone and dexmedetomidine on the onset and duration of anesthesia and duration of analgesia. Study was conducted to study the effect of dexmedetomidine with bupivacaine and dexamethasone with bupivacaine for prolongation of postoperative analgesia in infraclavicular brachial plexus block in upper limb orthopedic surgery. The study was done in 50 patients each in group dexmedetomidine (A) and dexamethasone (B). Group A received 0.25% bupivacaine (15 mL of 0.5% bupivacaine diluted to 30 cc) plus 50 µg of dexmedetomidine (1 mL) plus 1 mL distilled water (total volume 32 mL) and GROUP B was those who received 0.25% bupivacaine (15 mL of 0.5% bupivacaine diluted to 30 cc) plus 2 cc of dexamethasone. Duration of sensory and motor blockade was longer in dexamethasone group compared to dexmedetomidine. The time taken for the procedure, the onset of sensory blockade and motor blockade were noted. Onset of sensory and motor was earlier in group dexmedetomidine group. Duration of sensory and motor blockade was longer in dexamethasone group compared to dexmedetomidine ($p<0.001$). We conclude that onset of sensory and motor blockade is faster in dexmedetomidine group compared to dexamethasone group but duration of sensory and motor blockade is prolonged in dexamethasone group. Postoperative anaesthesia is prolonged in dexmeditomedine group.

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Key Words
Infraclavicular brachial plexus block, dexmedetomidine, dexamethasone

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INTRODUCTION

Industralisation has resulted in increase in various injuries to the people. So, providing postoperative analgesia and practical ways to prolong them is very crucial.

The infraclavicular block is a regional anesthetic technique developed to avoid the side effects and complications of supraclavicular blocks, particularly pneumothorax. It can be used for postoperative pain control for upper extremity surgeries such as the elbow, forearm, or hand[1,2]. Local anesthetics are commonly used for nerve blocks.

There are several studies which have proved that, dexmedetomidine as an adjuvant in nerve blocks extends the duration of analgesia[3,4]. Steroids have powerful anti-inflammatory as well as analgesic property. Perineurally injected steroids is reported to influence postoperative analgesia up for surgery safely. Dexamethasone microspheres have been found to prolong the block. Dexamethasone, a long-acting glucocorticoid (t1/2 >36 hrs) has potent anti-inflammatory and analgesic effects.

Dexmedetomidine prolongs the duration of sensory and motor block and provide a very good analgesia when used as an adjuvant. Because of the advent of nerve stimulator and peripheral nerve block techniques, even patients in ASA grade 3 and 4 can be done with stable haemodynamic variables.

Dexmedetomidine is a highly selective α-2 adrenergic agonist. Dexamethasone microspheres have been found to prolong the block. Dexamethasone, a long-acting glucocorticoid (t1/2 >36 hrs) has potent anti-inflammatory and analgesic effects[5,6]. There are very conflicting results when these two drugs are used in brachialplexus block in literature[7-11]. Hence we conducted aprospective observational study to assess the effects of dexamethasone and dexmedetomidine on block profile.

MATERIALS AND METHODS

The present comparative analytical observational study was conducted in a tertiary care hospital after obtaining approval from institutional ethical committee and written informed consent was obtained from each patient. All patients of upper limb orthopaedic surgeries who were being operated during the course of study period fulfilling the inclusion criteria were included. All the patients were explained about the study procedure. Then written informed consent was taken from the patients.

Sample size calculation: Considering confidence level 85 and margin of error of 5%. The sample given was 103 and 3 patients were lost to follow up, so actual sample size 100 patients. Study was conducted on 100 patients admitted for elective upper limb surgeries belonging to American Society of Anaesthesiologists (ASA) Grade I and II of either sex from 18-60 years of age.

Drugs and dosages:

- Group A was those who received 0.25% bupivacaine (15 mL of 0.5% bupivacaine diluted to 30 cc) plus 50 µg of dexmedetomidine (1 mL) plus 1 ml distilled water (total volume 32 mL)
- Group b was those who received 0.25% bupivacaine (15 mL of 0.5 % bupivacaine diluted to 30 cc) plus 8 mg of dexamethasone (2 mL). (Total volume 32 mL)

Monitoring: Standard monitors like pulse oximeter, ECG, blood pressure recording using sphygmomanometer

Needle puncture: With arm abducted at shoulder, coracoid process was palpated and skin mark placed at most prominent portion. Skin entry was placed at 2 cm medial and 2 cm caudal to the market coracoid process. Deeper infiltration was then performed with 25 gauge 5 cm PNS needle. A distal response was sought. The PNS was used to elicit the response.

Onset of sensory and motor block, duration of block and duration of analgesia were recorded.

- **Onset of sensory block:** Time from injection of drug till weak sensations (grade 2) in distribution of either radial, ulnar or median nerve

Assessment of sensory block: This was done by pinprick by 24 gauge needle, done every 10 min for first 30 min and time of weak sensations was recorded. Sensory block was graded using: Hollmen scale

  - **Grade 1:** Full sensation of pinprick
  - **Grade 2:** Weak sensation
  - **Grade 3:** Recognized as touch
  - **Grade 4:** No sensation felt

- **Onset of motor block:** Time of onset of motor blockade represented as the time passed to reach grade 1. (modified bromage scale)

  - **Grade 1:** Patient flexes his elbow and move his fingers but cannot raise his extended arm
  - **Grade 2:** Can move his fingers
  - **Grade 3:** Complete motor block

- **Duration of motor block:** Time interval between onset (grade 1) of block till Complete motor

functioning of forearm and hand.

After block is given time of complete motor block was noted. Complete duration of motor block postoperatively was assessed every hourly by asking the patients to move their fingers and to see whether they are able to raise their hands or not. This time was recorded and taken as cessation of motor block effect.

- **Duration of sensory block:** The total duration of the sensory block is the time that extended from grade 4 till the time when the Hollmen score was less than 4 was reached.

- **Assesment of post operative pain-(duration of analgesia):** The parameters were assessed for 24 hrs from the time of administration of block using (VAS 0-10, 0 = no pain, 10 = max pain), the time for rescue analgesia, any adverse effects such as nausea, vomiting and motor weakness were noted.

- Visual analogue score as:

    - **Grade 0 (0-1):** Good analgesia
    - **Grade 1 (1-4):** Moderate analgesia
    - **Grade 2 (4-7):** Mild analgesia
    - **Grade 3 (7-10):** No analgesia

Assessment of post-operative pain was done by visual analogue scale every half hourly till first 10 hrs and then hourly till 24 hrs .When the patient complained of worst pain or VAS score more than 6, rescue analgesic (i.v. Diclofenac 1-1.5 mg kg^{-1}) was given.

Onset of pain and requirement of rescue analgesia i.e., number given was assessed.

RESULTS

Demographic data of the two groups Between two groups demographic variables I.e., age, weight, gender distribution, between two groups were comparable (Table 1 and 2).

Figure 1-5 compares the time taken for onset of sensory blockade (time from injection of drug till weak sensation i.e., grade 2 in the two groups. The blockade was faster in group A of dexmedetomidine (8.58±0.19 min) compared to group B of dexamethasone (9.900±0.18 min): This difference was statistically significant (p<0.001).

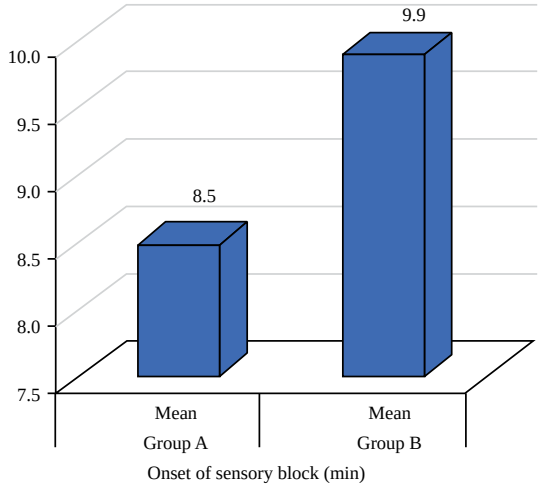

Fig. 1: Onset of sensory block (min)

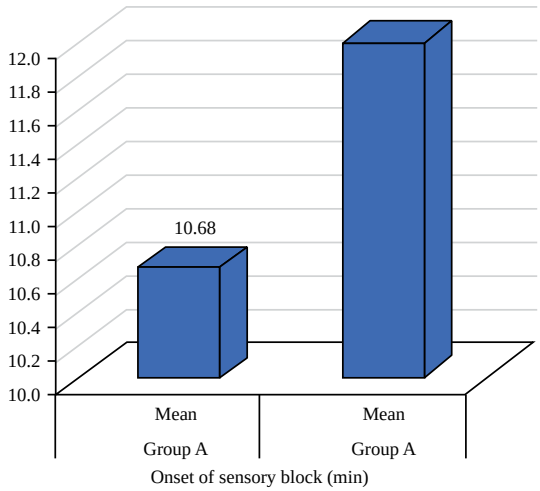

Fig. 1: Maen of motor block (min)

Table 1: Age-wise distribution of the patients

Demographic variable	Group A	Group B	p-value
Mean age	41.46±10.85	36.94±13.82	p value: 0.072
Gender	Males: 42	Males: 39	p-value: 0.610
	Females: 8	Females: 11	Chi square value: 0.259
Mean weight	58.36 kg	59.38	p-value 0.4280
Mean duration of surgery	85.90±40.10 min	98.20±36.45 mins	p value 0.112

Table 2: Distribution according parameters of block in each group

	Group A	Group B		
Block characteristics	----------Mean ----------		p-value	Remarks
Onset of sensory block (min)	8.58±0.19 min	9.900±0.18 min	<0.001	Significant
Mean onset of motor block	10.68±0.20 min	12.0±0.17 min	<0.001	Significant
Mean duration of sensory block (hrs)	8.03±0.11 hrs	9.28±0.12 hrs	<0.01	Significant
Mean duration of motor block (hrs)	9.42±0.12 hrs	11.37±0.13 hrs	<0.001	Significant
Mean duration of analgesia (hrs)	11.06 ± 1.48 hrs	13.00±1.58 hrs	<0.001	Significant

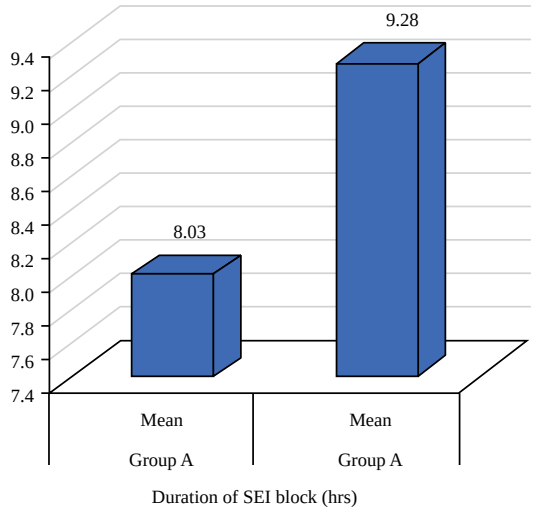

Fig. 3: Duration of sensory block (hrs)

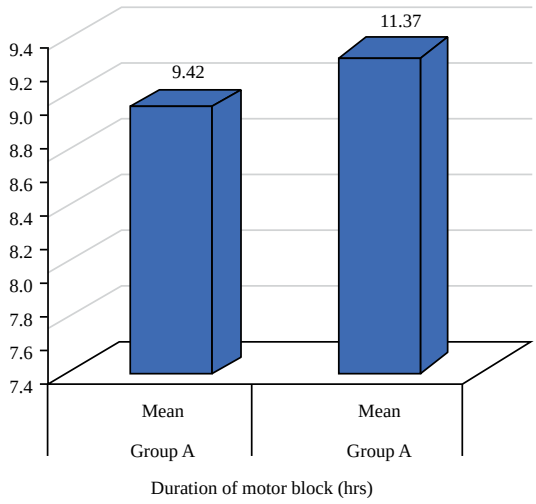

Fig. 3: Duration of motor block (hrs)

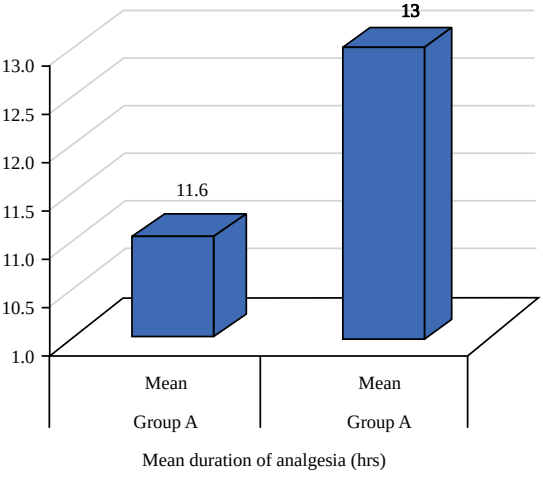

Fig. 3: Mean duration of analgesia (hrs)

DISCUSSIONS

The present study was conducted In Government medical college and hospital miraj after obtaining permission from the Ethical committee and Written informed consent was obtained from each patient.

About 100 patients ASA I and II with age group 18-65 years who posted for elective upper limb surgery were divided into 2 groups of 50 each (group A and B).

Group A received infraclavicular brachial plexus block with 0.25% bupivacaine with 50 mcg of dexmedetomidine and group B is who received 0.25% bupivacaine with 8 mg of dexamethasone (total volume 32 mL in each group).

Parameters that were observed included:

- Onset of sensory blockade
- Onset of motor block
- Duration of sensory blockade
- Duration of motor blockade
- Duration of analgesia

Onset of sensory block: Niranjan and Ranjan[8] found that sensory and motor block onset times were earlier in group dexmedetomidine as compared to group dexamethasone ($p<0.05$).

Yuvaraj Shashidhar found that onset of sensory block in dexmedetomidine group is earlier than dexamethasone group with statistically significant p value ($p<0.001$).

The mean time for onset of sensory block in group of dexmedetomidine was 7.45±1.10 min and in group of dexamethasone was 10.15+1.14 min. Our study concurs well with the study conducted by them.

Study conducted by Kaur *et al.*[12] found that almost similar onset of sensory block in dexmedetomidine group (5.6 min) compared to dexamethasone group (6.2 min) Our study result showed early onset of sensory block in dexmedetomidine group. In their study they used 2% lignocaine plus adrenaline along with 0.5% bupivacaine. This may be responsible for the contrary result.

Onset of motor block: In our study, we observed that onset of motor block was earlier in Dexmedetomidine group with the mean value of 10.68±0.20 min and in comparison, the dexamethasone group had a mean value of 12.0±0.17 min. which is statistically significant ($p<0.001$).

This observation well matches with the study conducted by Verma. The sensory and motor block onset times was earlier in group dexmedetomidine compared to group Dexamethasone ($p<0.05$). Mean onset time of motor block in dexmedetomidine was 14.12±1.6 min compared to dexamethasone group with 18.01 4.5± 1 min with $p = 0.052$.

Yuvaraj Shashidhar study results regarding mean onset of motor block in dexmedetomidine and dexamethasone group supports our conclusion.

They found that the mean time for onset of motor block in group of dexmedetomidine was 10.60±1.05 min and in group dexamethasone was 14.95±0.83 min with p<0.001.

Study conducted by Kaur *et al*.[12] found faster onset of motor block in dexmedetomidine group compared to dexamethasone group.

Our study differed from the study done by Myeong Jong Lee *et al*.[7]. They found that there was no significant difference in onset of analgesia and motor block between the groups. This may probably be because of the slightly higher dose of drugs (10 mg dexamethasone vs. 100 µg dexmedetomidine) used by them and also because they used both ultrasound and peripheral nerve stimulation which would have resulted in a more precise deposition of the drug.

Duration of sensory block: The duration of sensory blockade, in our study was 9.28±0.12 hrs with dexamethasone group group and 8.03±0.11 hrs for dexmedetomidine group, which is statistically significant (p<0.0001). This study well concur with the study conducted by the naveen kumar. The duration of sensory block in dexamethasone group is found to be 637.66±237.77 min . The duration of sensory block in dexmedetomidine is found to be 451.56±129.30 min. which is statistically significant p = 0.038.

According to study conducted by Adinarayanan *et al*.[13], duration of sensory block as an adjuvant to bupivacaine, dexamethasone significantly extends the duration of supraclavicular brachial plexus block compared to dexmedetomidine. They used 0.5 % concentration of bupivacaine. In their study, Group A with dexamethasone had 1619.29±235.49 min duration of sensory block compared to group B of dexmedetomidine had 1084.14±207.58 min which is statistically significant p<0.01.

Our study result significantly deviated from the study conducted by Hamada *et al*.[10]. They concluded that addition of dexmedetomidine to bupivacaine prolonged the time of block and analgesia duration longer than dexamethasone. The duration sensory block in dexmedetomidine group was 19.00±1.80 hrs compared to dexamethasone with duration of sensory block 12.03±1.54 hrs. This contrary result may be due to higher concentration of dexmedetomidine in brachial plexus block I.e., 1 mcg kg^{-1}. They also used only 4 mg of dexamethasone in brachial plexus block. In our study we used 8mg of dexamethasone.

Duration of motor block: In our study, the duration of motor blockade was found to be 11.37±0.13 hrs in Group dexamethasone compared to group of dexmedetomidine 9.42 ± 0.12 hrs and this difference was statistically significant (p = 0.001).

Swaminathan *et al*.[13] found that the duration of motor block in dexamethasone group Is 1303.93±233.71 min and that of dexmedetomidine had a motor duration of 888.62±57.92 min with a statistically significant p<0.01. They concluded that dexamethasone has more longer duration of motor block compared to dexmedetomidine group. Our study result matches well with their conclusion.

Duration of analgesia: The mean time from onset of block to request of analgesia was taken as total duration of analgesia. It was 13±1.58 hrs in dexamethasone group and 11.06±1.48 hrs in dexmedetomidine group which is statistically significant p<0.001.

According to Kumar[9] duration of analgesia In Dexamethasone group 637.66±237.77 min and in dexmedetomidine group 451.56±129.30 min and with a P value of 0.038 which is statistically significant. Our study result concur well with them.

Study conducted by Kaur *et al*.[12] found different result regarding duration of analgesia than our study. Mean duration of analgesia was prolonged in dexmedetomidine group (874.6 min) compared to dexamethasone group (772.6 min). This contrary result may be due to more dose of local anesthetics compared to our study. Also they used 0.5% concentration of bupivacaine along with adrenaline and lignocaine.

LIMITATIONS

There are certain limitations in our study. We not had control group of plain 0.25% bupivacaine to compare the block characteristic with that of dexamethasone and dexmedetomidine group.This was because we wanted to prolong the postoperative analgesia. We did not record the sedation score to study the effect of perineural dexmedetomidine on sedation. We had used fixed dose dexmedetomidine i.e. not according to weight of the pt.

CONCLUSION

We thus concluded that both dexamethasone and dexmedetomidine are good adjuvant with bupivacaine for infraclavicular brachial plexus block. However dexmedetomidine had a faster onset of sensory and motor block and dexamethasone longer duration ofaction.

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