

Comparative study of bupivacaine with dexmedetomidine and only bupivacaine during brachial plexus block

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Abstract

Introduction: Regional anaesthesia techniques are very successful in alleviating pain during and after various surgical procedures. During upper extremity surgery Supraclavicular Brachial plexus block is commonly administered. Various methods had been tried to extend the period of analgesia intra and post-operative. When dexmedetomidine along with Bupivacaine is used the anaesthesia and the analgesia requirements are reduced to a large extent.

Aims and Objectives: The study was carried out to study the effect of adding Dexmedetomidine with Bupivacaine in the supraclavicular brachial plexus block.

Material and Methods: In the present randomized, double blind and prospective study on 60 cases of ASA grade 1 and grade 2, within in the age group between 18-60 years from a tertiary care medical college was conducted between Jan 2015 - Dec 2015. Group B (control): received 0.25% Bupivacaine while Group D (case): received 0.25% Bupivacaine plus 30µg Dexmedetomidine. Various parameters were studied.

Results: It was found that onset of sensory block was early in Dexmedetomidine group cases. It was also observed that motor block onset was early in dexmedetomidine group and statistically highly significant. The period of sensory and motor block was significantly extended in group (D) in comparison to that of group (B). The analgesia duration was also prolonged.

Conclusion: From the results we concluded that addition of Dexmedetomidine to Bupivacaine provide early onset of sensory and motor block and prolongs blockade and duration of analgesia.

Keywords: Peripheral nerve block, Dexmedetomidine, Bupivacaine, Duration, Onset

Introduction

Pain is as old as human life. The most human experiments in chemistry have been in the discovery of chemical compounds that will alleviate pain. Pain is defined as an unpleasant sensory and emotional experience associated with actual damage or potential tissue damage or described in terms of such damage by International Association for the Study.⁽¹⁾ Rightly coined the phrase "Pain: The 5th Vital Sign" to bring awareness of pain management among health care professionals.⁽²⁾

Regional anaesthesia is very successful as much general anaesthesia in alleviating pain during and after various surgical procedures. The importance of peripheral nerve blocks (PNB) has expanded from the operation theatres to the postoperative and chronic pain management. PNB are achieved by injecting local anaesthetic solution around a nerve root to produce anaesthesia in the distribution of that nerve.⁽³⁾ The advantages of a single shot PNB are rapid onset, predictable and depth of anaesthesia, a relatively simpler technique, adequate muscle relaxation and adequate post-operative analgesia. It supports early ambulation, early oral intake, avoids intubation and its complications with lesser systemic side effects and postoperative side effects.⁽⁴⁾

Brachial Plexus Block is one of the most commonly administered block since it offers almost complete anaesthesia and analgesia for surgeries of the

upper extremities. For brachial plexus block Supraclavicular approach which is carried out at the level of trunks of brachial plexus gives the most effective block for all portion of upper extremity. With the various local anaesthetics used in Supraclavicular block the duration of analgesia is a major limiting factor. However, there are many limitations like delayed onset of action, patchy or incomplete analgesia etc. Various methods had been practiced to overcome this limitation like using higher volume of local anaesthetics with limited success as it may increase the risk of LA systemic toxicity.⁽⁵⁾ Bupivacaine has been most commonly used local anaesthetic solution in brachial plexus block for its property of long duration of action. So Bupivacaine was included as local anaesthetic in present study. Many adjuvants like morphine, tramadol, fentanyl,⁽⁶⁾ buprenorphine, clonidine⁽⁷⁾ has been used as adjuvant to prolong the duration of block and postoperative analgesia along with Bupivacaine.

Dexmedetomidine is a selective α_2 adrenergic agonist with greater affinity than clonidine.⁽⁸⁾ Various studies have shown that dexmedetomidine prolongs the duration of sensory and motor block and provides very good analgesia when used as an adjuvant to LAs for nerve blocks.^(9,10) Because of its analgesic properties the anaesthetic and the analgesic requirement get reduced to a huge extent by the use of dexmedetomidine^(11,12) and it augments the local anaesthetic effects. It

maintains hemodynamic parameters and the decreases oxygen demand due to enhanced sympathoadrenal stability. For the above mentioned advantages dexmedetomidine was included as an adjuvant to Bupivacaine in brachial plexus block in present study. Considering the relatively lower body weight in Indians it was decided to use low dose Dexmedetomidine (30 µg) in present study. In the present study the various effects of addition of dexmedetomidine to Bupivacaine for supraclavicular brachial plexus block in upper limb orthopedic surgery was evaluated with only Bupivacaine (0.25%).

Aims and Objectives

To compare the various effects of addition of Dexmedetomidine to Bupivacaine in supraclavicular brachial plexus block.

1. Compare the time period of sensory block and motor block onset.
2. Compare the time period of sensory and motor blockade
3. Compare the time period of analgesia
4. To compare the Sedation score

Material and Methods

After obtaining approval from ethical committee and informed and written consent, 60 patients were included in the study.

Inclusion criteria: patients of grade- 1 and 2 ASA, of the age group of 18-60 years, orthopaedic patients posted for upper extremity surgery below the shoulder in tertiary care centre between Jan 2015 - Dec 2015. All the patients were given brachial plexus block by Classical supraclavicular approach.

Study design: The present study is controlled and prospective, double blind study. Patient's random allocation to Group- B and Group-D was done by using a standard randomization code technique.

Group B (control): Patients were administered with 0.25% Bupivacaine (38ml) plus 2ml normal saline to make a total 40 ml of volume. **Group D (case):** Patients received 0.25% Bupivacaine (38ml) plus 30µg Dexmedetomidine to make a total volume of 40 ml. Drug solutions were prepared by an anaesthesiologist not involved in the study **Exclusion criteria:** ASA Grade 3 patients and above, patients having history of blood coagulation disorder and patients on anticoagulation therapy, Pre-existing peripheral neuropathy, Infection at the puncture site, previous allergy to local anaesthetic, Pregnant women, Inadequate block. Patients underwent thorough clinical examination and investigations. **Monitoring:** Standard monitors were attached like pulse oximetry for saturation (SpO₂), ECG, NIBP.

The following parameters were observed intra and post-operative period.

1. **Time period of onset of sensory block:** The time interval between the end of local anaesthetic

administration and complete sensory block in each of the major peripheral nerve distributions. Sensory block was assessed by pin prick method at 0, 2, 5, 10, 15, 20, and 30 min. time interval. Sensory block was assessed according to the following scale: 0 = no block(normal sensation), 1 = partial block(decreased sensation), and 2 = complete block(no sensation).

2. **Time period of onset of motor block:** The time interval between total local anaesthetic administration and complete motor block (grade 2). Motor block was measured at 0, 10, 20, and 30minutes interval by assessing the following motor functions: flexion at the elbow, extension of the elbow and the wrist, opposition of the thumb and index finger and opposition of the thumb and small finger. Motor block was assessed according to the following scale: 0 = no block (full muscle activity), 1 = partial block (decreased muscle activity), and 2 = complete block (no muscle activity).
3. **Time period of sensory block:** the time interval between the end of LA administration and the complete resolution of anaesthesia (score 0 on three-point scale) on all nerves. The duration of sensory block was assessed by pin prick method postoperatively every hour.
4. **Time period of motor block:** the time interval from complete motor block to complete recovery of motor function of hand and forearm (grade 0). The duration of motor block postoperatively was assessed by movement fingers and hand raise or not at every hour.
5. **Time period of analgesia:** Anaesthesia was considered satisfactory if there was no complain of any pain or discomfort and if no sedation was required intra operatively. Post-operative follow up was done in the recovery room and post-operative ward. The duration of analgesia was noted by using 0-10 visual analogue score (VAS) for pain at every half an hour for first 10 hours and then hourly till 24 hours. When the patients began to experience the pain (VAS =8-10), it was considered that analgesic action of the drugs was terminated and rescue analgesic (IM Diclofenac 1-1.5mg/kg) was given.
6. **Sedation score:** Sedation score described by University of Michigan Sedation Scale (UMSS) issued to assess sedation. i) Awaked & Alert ii) minimally Sedated: tired/ sleepy, responding to verbal stimulus iii) Moderately Sedated: somnolent/sleeping, responding to mild stimulus iv) Deeply Sedated: deep sleep, responding to moderate to severe physical stimulus v) Unarousable.

Results

The present prospective study compared Dexmedetomidine as an adjunct to Bupivacaine (local anaesthetic) in Supraclavicular brachial plexus block.

At the end of study, the collected data was analysed statistically and tabulated, the patient characteristics noted.

Following are observations and results of study.

Table 1: Distribution of cases according to Comparison of change of Systolic Blood Pressure (SBP) between two groups

| SBP (mm Hg) | Groups | n | Mean \pm S.D. (mm Hg) | t-value (d.f.=58) | p-value | Decision (Based on p-value) |
|-------------|-----------|----|-------------------------|-------------------|---------|-----------------------------|
| Base Line | Group (B) | 30 | 115.87 \pm 7.75 | 0.65 | 0.518 | Non-Significant |
| | Group (D) | 30 | 117.13 \pm 7.33 | | | |
| 5 Minute | Group (B) | 30 | 114.93 \pm 7.37 | 0.11 | 0.914 | Non-Significant |
| | Group (D) | 30 | 114.73 \pm 6.88 | | | |
| 15 - Minute | Group (B) | 30 | 114.87 \pm 8.06 | 0.43 | 0.671 | Non-Significant |
| | Group (D) | 30 | 114.07 \pm 6.34 | | | |
| 30- Minute | Group (B) | 30 | 114.47 \pm 7.27 | 0.68 | 0.496 | Non-Significant |
| | Group (D) | 30 | 113.27 \pm 6.27 | | | |
| 60- Minute | Group (B) | 30 | 115.07 \pm 7.68 | 0.25 | 0.805 | Non-Significant |
| | Group (D) | 30 | 115.53 \pm 6.86 | | | |
| 120- Minute | Group (B) | 30 | 115.87 \pm 6.81 | 0.55 | 0.587 | Non-Significant |
| | Group (D) | 30 | 116.87 \pm 7.37 | | | |

d.f. = degree of freedom ($n_1 + n_2 - 2$) = (30 + 30 - 2) = 58, **For preoperative SBP:** Unpaired T test, T = 0.65, df = 58; P = 0.518 as P > 0.05 hence non-significant. No significant difference was observed in systolic blood pressure between two groups as compared to baseline.

Table 2: Distribution of cases according to Changes of Mean SpO₂ (%)

| Groups | Mean SpO ₂ (%) at different time | | | | | |
|-----------|---|-------|--------|--------|--------|---------|
| | Preoperative | 5-min | 15-min | 30-min | 60-min | 120-min |
| Group (B) | 97.77 | 98.23 | 98.26 | 97.96 | 98.40 | 98.07 |
| Group (D) | 98.13 | 98.30 | 98.20 | 97.93 | 98.40 | 98.13 |

d.f. = degree of freedom ($n_1 + n_2 - 2$) = (30 + 30 - 2) = 58, **For preoperative SpO₂:** Unpaired T test, T = 0.90, df = 58; P = 0.375 as P > 0.05 hence non-significant.

There was no significant difference in SpO₂ (%) between two groups compared to baseline.

Table 3: Distribution of cases according to the onset of sensory blockade

| Groups | n | Mean \pm S.D. (Minute) | t-value (d.f.=58) | p-value | Decision (Based on p-value) |
|-----------|----|--------------------------|-------------------|---------|-----------------------------|
| Group (B) | 30 | 12.94 \pm 0.66 | 29.01 | 0.000 | Highly Significant |
| Group (D) | 30 | 8.55 \pm 0.50 | | | |

d.f. = degree of freedom ($n_1 + n_2 - 2$) = (30 + 30 - 2) = 58. **Onset of sensory block:** Unpaired T test, T = 29.01, df = 58; p = 0.000 as P < 0.05 hence highly significant.

Table 4: Distribution of cases according to onset of motor blockade

| Groups | n | Mean \pm S.D. (Minute) | t-value (d.f.=58) | p-value | Decision (Based on p-value) |
|-----------|----|--------------------------|-------------------|---------|-----------------------------|
| Group (B) | 30 | 18.24 \pm 0.88 | 22.30 | 0.000 | Highly Significant |
| Group (D) | 30 | 13.54 \pm 0.74 | | | |

d.f. = degree of freedom ($n_1 + n_2 - 2$) = (30 + 30 - 2) = 58. **Onset of motor block:** Unpaired T test, T = 22.30, df = 58; p = 0.000 as P < 0.05 hence highly significant.

Table 5: Distribution of patients according to period of sensory blockade

| Groups | n | Mean ± S.D. (Minute) | t-value (d.f.=58) | p-value | Decision (Based on p-value) |
|-----------|----|-------------------------|----------------------|---------|--------------------------------|
| Group (B) | 30 | 205.83 ± 6.58 | 170.98 | 0.000 | Highly Significant |
| Group (D) | 30 | 534.63 ± 8.22 | | | |

d.f. = degree of freedom ($n_1 + n_2 - 2$) = (30 + 30 - 2) = 58, **Duration of sensory block:** Unpaired T test, T = 170.98, df = 58; p=0.00 as P < 0.05 hence highly significant.

Table 6: Distribution of cases according to duration of analgesia

| Groups | n | Mean ± S.D. (Minute) | t-value (d.f.=58) | p-value | Decision (Based on p-value) |
|-----------|----|-------------------------|----------------------|---------|--------------------------------|
| Group (B) | 30 | 281.97 ± 7.67 | 81.20 | 0.000 | Highly Significant |
| Group (D) | 30 | 661.8 ± 24.4 | | | |

d.f. = degree of freedom ($n_1 + n_2 - 2$) = (30 + 30 - 2) = 58

Duration of Analgesia: Unpaired T test, T = 81.20, df = 58; p=0.00 as P < 0.05 hence highly significant.

Discussion

In the present study, the most effective supraclavicular approach to brachial plexus block was selected which all the portions of the upper extremity.^(4,13) There are many studies with Dexmedetomidine 50-100µg which have used it as an adjuvant in block to extend the duration of blockade and postoperative analgesia but they found dose dependant side effects like bradycardia and sedation. So, the present study was carried out to see the effect of Dexmedetomidine 30µg as adjuvants to Bupivacaine in supraclavicular brachial plexus block.

Selection of Patients: All our patients were in the age group of 18 to 60 years. The selection of patients according to age and sex was random, provided the patients were ASA grade 1 or 2.

Demographic profile: In our study, the mean age of patients in group (B) was 30.87 ± 8.02 years and in group (D) was 31.67 ± 9.25 years. After applying unpaired 't' test; there was no significant difference in the two groups statistically (p > 0.05). (Table 1) The demographic profile, between two groups, which was statistically insignificant (P= 0.722 as P > 0.05) of our patients was similar with other research studies and provided us the scientific platform to compare the results obtained.

Onset of Sensory and Motor Blockade: The mean time of onset of sensory block was 12.94 ± 0.66 minutes in group (B) and 8.55 ± 0.50 minutes in group (D). The mean time for onset of motor blockade was 18.24 ± 0.88minutes in group (B) and 13.54 ± 0.74minutes in group (D). Using unpaired 't' test; there was highly significant. In our study we found that, Dexmedetomidine shortened the onset of sensory block and motor block when added to Bupivacaine for supraclavicular brachial plexus block.

In a randomized study by **G.H. Megha**⁽¹⁴⁾ (2014) Concluded that addition of inj. dexmedetomidine to Bupivacaine in brachial plexus block reduces onset of sensory and motor block.⁽¹⁴⁾ This was comparable to our study.

In a study by **Kaur H et al**⁽¹⁵⁾ (2015) adding dexmedetomidine to levoBupivacaine for supraclavicular brachial plexus block observed that addition of 1µg / kg dexmedetomidine to 0.25% levoBupivacaine for supraclavicular plexus block reduces onset time of sensory and motor block.⁽¹⁵⁾ This was comparable to our study.

Duration of Sensory and Motor Block: In present study, the mean duration of Sensory block was 205.83 ± 6.58minutes in group (B) & 534.63 ± 8.22 minutes in group (D). The mean duration of motor block were 169.43 ± 5.83 in group (B) and 434.63 ± 8.22 minutes in group (D). (Table 9) It showed that the duration of sensory block, motor block was significantly prolonged group (D) as compared to the group (B).

Following studies are comparable with our study, have shown that adding of dexmedetomidine to local anaesthetics effectively and significantly prolongs the duration of sensory and motor block. **Esmaoglu A et al**⁽¹⁶⁾ (2010) evaluated the effect of adding dexmedetomidine to levoBupivacaine for axillary brachial plexus block. They concluded that Dexmedetomidine when added to levoBupivacaine for axillary brachial plexus block prolongs the duration of the block. Similar results were found by **Kayacan U et al**⁽¹⁷⁾ (2012) and **Ammar AS**⁽¹⁸⁾ (2012). This was comparable to our study.

In a study conducted by **Swami SS et al**⁽¹⁹⁾(2012) for Comparison of dexmedetomidine and clonidine as an adjuvant to local anaesthetic in supraclavicular brachial plexus block found that dexmedetomidine when added to local anaesthetic in supraclavicular brachial plexus block increases the duration of motor and sensory block.⁽¹⁹⁾ This was comparable to our study.

Biswas S⁽²⁰⁾(2014)from Malda Medical College and Hospital, Malda, India Conducted a Randomized Double Blinded Prospective Study to studied the effect of adding dexmedetomidine with levobupivacaine in brachial plexus block in supraclavicular route. They concluded that Dexmedetomidine when added to

levoBupivacaine in supraclavicular brachial plexus block prolongs the duration of block.⁽²⁰⁾ This was comparable to our study.

Zhang Y et al⁽²¹⁾ (2014) evaluated effects of adding dexmedetomidine to Ropivacaine. They found that when Dexmedetomidine added to ropivacaine for an axillary brachial plexus block increases the duration of the block. This is comparable to our study.

In 2015 double-blind study conducted by **Sandhya Agarwal et al⁽²²⁾** on effect of adding dexmedetomidine to Bupivacaine in supraclavicular brachial plexus block. They observed that duration time sensory block (min) 234.8 ± 47.9 , 755.6 ± 126.8 . Duration time motor block (min) 208.0 ± 22.7 , 702.0 ± 111.6 in Bupivacaine group and dexmedetomidine group respectively. They concluded that the same results as comparable to our study.

In a study conducted by **Atul Dixit et al⁽²³⁾** in 2015 the effect of adding dexmedetomidine to LevoBupivacaine in supraclavicular brachial plexus block was studied. They found that duration of sensory block was 15.55 ± 0.605 hours and 11.10 ± 1.373 , mean duration of motor block 13.85 ± 0.366 hours, and 9.10 ± 1.119 hours in group L+D and group L respectively.

Duration of Analgesia: Duration of analgesia was 281.97 ± 7.67 minutes in group (B) whereas in group (D) was 661.80 ± 24.4 minutes (Table 10). The duration of analgesia is significantly prolonged in group (D) as compared to the group (B). So our study observed that Along with Bupivacaine - Dexmedetomidine prolongs the duration of analgesia.

One trial carried by **Ammar AS et al⁽¹⁸⁾** (2012) in infraclavicular brachial plexus block using Bupivacaine alone or combined with dexmedetomidine has extends analgesia (403 vs. 233 min, $P=0.002$), and lowers morphine requirements for 48 hours after surgery (4.9 (0–8.0) vs. 13.6 mg (4.0 – 16.0) mg). They concluded that by adding dexmedetomidine to Bupivacaine during infraclavicular brachial plexus block provides prolonged duration of analgesia. This was comparable to our study. **G.H. Megha et al⁽¹⁴⁾**(2014) carried out double blind and randomized study by adding dexmedetomidine as adjuvant in block Duration of analgesia was found to be 970.36 ± 80.7 min in dexmedetomidine group and 300 ± 40.31 min in normal saline group was found statistically significant. Concluded that addition of inj.dexmedetomidine to Bupivacaine in brachial plexus block increases the duration of analgesia. This was comparable to our study. In 2015 double-blind study conducted by **Sandhya Agarwal et al⁽²²⁾** on effect of adding dexmedetomidine to Bupivacaine in supraclavicular brachial plexus block. They observed that duration of analgesia for group SD was 776.4 ± 130.8 min, it was 242.4 ± 51.2 min for group S. DOA was significantly longer in group SD than group S ($P < 0.001$). Concluded that Dexmedetomidine added as an adjuvant to

Bupivacaine for supraclavicular block prolongs duration of analgesia. This was comparable to our study.

Summary

The present study was carried out to compare the onset of sensory and motor blockade, duration of Sensory and motor block, duration of analgesia and side effects after injection of dexmedetomidine added to Bupivacaine in brachial plexus block in patient with upper limb surgery in the tertiary care centre between Jan 2015-Dec 2015. The study included total 60 patients posted for elective upper limb surgery.

Onset of sensory blockade: The onset of sensory blockade was early in Dexmedetomidine group and statistically highly significant.

Onset of motor block: The onset of motor blockade was early in Dexmedetomidine group and statistically highly significant.

Duration of sensory and motor block: The duration of sensory block in group (B) was 205.83 ± 6.58 minutes whereas in group (D) it was 534.63 ± 8.22 minutes. And the duration of motor block in group (B) and group (D) were 169.43 ± 5.83 and 434.63 ± 8.22 minutes respectively (as $P < 0.001$). The duration of sensory block and motor block was significantly prolonged group (D) as compared to the group (B).

Duration of analgesia: The duration of analgesia in group (B) was 281.97 ± 87.67 minutes whereas in group (D) it was 661.80 ± 24.40 minutes respectively. This data shows that duration of analgesia was prolonged in group (D) and highly significant statistically (As $P < 0.001$). So our study showed that dexmedetomidine prolongs the duration of analgesia.

Conclusion

We can conclude that,

1. Dexmedetomidine when added to Bupivacaine provides early onset of sensory and motor block.
2. Longer duration of sensory and motor blockade was achieved by adding dexmedetomidine to Bupivacaine.
3. Addition of dexmedetomidine to Bupivacaine provided extended duration of analgesia
4. Sedation was not associated with Dexmedetomidine.
5. In conclusion, use of dexmedetomidine in combination with Bupivacaine in supraclavicular brachial plexus block produced early onset, longer duration of sensory and motor block, extended duration of postoperative analgesia without any major adverse events.

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