Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

# COMPARISON OF THE EFFICACY DEXMEDETOMIDINE AND FENTANYL AS AN ADJUNCT TO LEVOBUPIVACAINE IN ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

**Dr Karthick G[1], Dr Subbulakshmi Sundaram[2], Dr Santhosh T[3]**

[1]Junior Resident, Department of Anaesthesiology, Government Medical College and Hospital, Cuddalore, Annamalai Nagar-608002, India.
[2]Associate Professor, Department of Anaesthesiology, Government Medical College and Hospital, Cuddalore, Annamalai Nagar-608002, India.
[3]Assistant Surgeon, Department of Anaesthesiology, Government Medical College and Hospital, Cuddalore, Annamalai Nagar-608002, India.

Received Date: 20/10/2024 Acceptance Date: 21/11/2024

**Corresponding Author:** Dr Karthick G, Junior Resident, Department of Anaesthesiology, Government Medical College and Hospital, Cuddalore, Annamalai Nagar-608002, India.
**Email:** gekaye@gmail.com

## ABSTRACT

**Background:** Ultrasound-guided supraclavicular block is of increasing importance in upper limb surgeries as it provides excellent pain control and reduced side effects. The search for the ideal adjuvant is still present. In this study, we aim to evaluate the efficacy and safety of dexmedetomidine, and fentanyl when added to levobupivacaine in ultrasound-guided supraclavicular block. **Aim and Objective:** To compare the efficacy dexmedetomidine and fentanyl as an adjunct to levobupivacaine in ultrasound guided supraclavicular brachial plexus block for upper limb surgeries. To compare the onset and duration of sensory and motor blockade, duration of analgesia and haemodynamic parameters between 50mcg of dexmedetomidine and 50mcg of fentanyl with 0.5% levobupivacaine in ultrasound guided supraclavicular brachial plexus block for upper limb surgeries. **Materials and Methods:** This Double blinded comparative study was conducted on 30 adult patients undergoing upper limb surgeries belonging to ASA I and II. The Subjects randomly allocated into two groups, 15 in each group. Ultrasound guided supraclavicular brachial plexus block was performed on two groups, Group D received 30 ml of 0.5% levobupivacaine with 50mcg dexmedetomidine and group F received 30 ml of 0.5% levobupivacaine with 50mcg fentanyl. Onset and duration of sensory and motor block and duration of analgesia were studied as primary outcome and hemodynamic parameters, complications were studied as secondary outcome. **Results:** Group D, there was a statistically significant shortening of onset time and prolongation of duration of both sensory (748.4+57.2) and motor block (780.7+53.5) compared group F. Duration of analgesia (816.7+55.6) was also prolonged in group D. **Conclusion:** Dexmedetomidine showed significant improvement in onset and duration of sensory and motor blockade, prolong the duration of block and analgesia compared to fentanyl as adjuvant to levobupivacaine in ultrasound guided supraclavicular brachial plexus block for upper limb surgeries.

**Keywords:** Dexmedetomidine, Fentanyl, Levobupivacaine, Supraclavicular brachial plexus block**.**

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

## INTRODUCTION

Regional anesthesia techniques offer several advantages over general anesthesia by limiting the area anesthetized, thereby increasing patients' satisfaction, reducing the length of hospital stay, and lowering overall healthcare costs [1]. One such technique is the brachial plexus block that has become the primary anesthetic modality for most upper extremity surgeries [2]. The block may be administered via the supraclavicular, infraclavicular, axillary, or interscalene approach with each technique having its advantages and disadvantages [3]. The addition of ultrasound has improved the success of the technique by allowing the operator to visualize the needle position and administer the block in patients with anatomical variation [4]. However, a limitation of plain local anesthetic brachial plexus block, or for that matter any peripheral nerve block, is the short duration of anesthesia even with long-acting agents.

Although bupivacaine remains commonly used local anaesthetic for performance of nerve blocks, levobupivacaine, a less cardiotoxic s- isomer of bupivacaine, is proved to be like bupivacaine if not for pharmaco-economic considerations, hence, proposed as a safer alternative to the former for the performance of nerve blocks. Local anaesthetics with additives improve quality and the extend duration of block [15]. Adjuvants like opioids, dexmedetomidine have been administered concomitantly with local anaesthetics with the possibility of providing post-operative analgesia in addition to improved quality of anaesthesia.

Alpha 2 adrenergic agonists not only decrease the requirements of intraoperative anesthetic agents, but also, they have cardiovascular stabilizing properties, sympatholytic analgesic and sedative property. To reduce the time of onset of nerve block, to prolong the duration of block and to improve the quality of blockade, these can be given in peripheral nerve blocks, intrathecal, epidural either alone or with local anesthetic agents. 2,4 An α2 receptor agonist, dexmedetomidine, is eight times more sensitive than clonidine. The activation of inwardly rectifying G1 protein-gated potassium channels, resulting in membrane hyperpolarisation and decrease in the excitability of the CNS cells and the reduction of calcium conductance into the cells, inhibiting neurotransmitter release, are the probable mechanisms of action of dexmedetomidine.

Fentanyl is a potent synthetic opioid analgesia with a strong agonistic action at the μ-opioid receptor with a rapid onset and short duration of action. Fentanyl, when added to local anaesthesia in peripheral nerve blocks, potentiates the local anaesthesia action via central opioid receptor-mediated analgesia by the peripheral uptake of fentanyl to the systemic circulation.

Therefore, in the present study was to compare the Effectiveness of Dexmedetomidine and Fentanyl as Adjuvants to Ropivacaine in Ultrasound guided Supraclavicular brachial plexus block in terms of onset of sensory blockade, motor blockade, duration of analgesia

## MATERIALS AND METHODS

The study was randomized double blinded comparative study conducted on 30 adult patients divided into two groups.

Ultrasound guided Supraclavicular Brachial Plexus Block was performed on 30 adult patients divided into two groups with 15 patients in each group.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

| GROUP LF | GROUP LD |
|---|---|
| 30 ml of 0.5% Levobupivacaine with 50mcg Fentanyl | 30 ml of 0.5% Levobupivacaine with 50mcg Dexmedetomidine |

**Inclusion Criteria**

1. Patients aged 18-60 years scheduled for upper limb surgeries
2. ASA grade of I and II

**Exclusion Criteria**

1. Patients who refused to be part of the study.
2. Patients with significant coagulopathies.
3. Patients with psychiatric history.
4. Patients allergic to amide local anaesthetic agents.
5. Pregnant patients.
6. ASA III -V.

The patients and the anaesthesiologists performing blocks were blinded to the study groups. The drug solutions were prepared by an anaesthesiologist blinded to the study groups and not involved in the study. One group received 30 ml of 0.5% levobupivacaine with 50mcg dexmedetomidine and another group received 30 ml of 0.5% levobupivacaine with 50mcg fentanyl. After securing a patent intravenous cannula on the non-operating hand, baseline heart rate (HR), non-invasive blood pressure (NIBP) and oxygen saturation were recorded (SpO2). ECG and SpO2 were monitored continuously, and blood pressure was monitored. Supraclavicular block was performed using ultrasound.

Sensory blockade was assessed by pin prick method, motor blockade was assessed using modified bromage scale.

Both sensory and motor block were assessed every 3 minutes till their onset and every 30 minutes after completion of the procedure till the blocks were resolved. The subjective recovery of sensations, movement and pain were recorded. HR, BP and SpO2 were recorded at 0 minute (immediately after drug administration) and then 5, 10, 15, 30, 45, 60,90 and 120 minutes from the time of drug administration.

Postoperative analgesia was monitored using VAS scale, When the subject's visual analogue score >4, a rescue analgesia like intramuscular diclofenac sodium 75mg (1.5mg/kg) was administered.

## RESULTS

Both the groups were comparable regarding age, weight, sex and baseline SBP, DBP, HR and SpO2.

**TABLE 1: COMPARISON OF DEMOGRAPHIC DATA AND BASE LINE HEMODYNAMIC PARAMETERS**

| Variables | LF | LD | P Value |
|---|---|---|---|
| Age (Years) | 34.4+8.2 | 35.9+8.9 | 0.425 |
| Weight (Kg) | 65.2+7.6 | 67.3+9.8 | 0.449 |
| M: F Ratio | 8:7 | 9:6 | 0.524 |
| Baseline SBP (mmHg) | 119.9+8.7 | 120.6+8.9 | 0.459 |
| Baseline DBP (mmHg) | 79.7+6.4 | 78.2+7.2 | 0.620 |

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

| | | | |
|---|---|---|---|
| Baseline HR (bpm) | 76.0+6.3 | 77.9+9.1 | 0.459 |

Age, weight, baseline SBP, DBP, and HR were expressed as Mean+Standard Deviation Male: Female ratio expressed as number of males and females in each group.
In LD group, there was a statistically significant shortening of onset time and prolongation of duration of both sensory and motor block compared LF group. Duration of analgesia was also prolonged.

**TABLE 2: COMPARISON OF BLOCK PARAMETERS**

| Variables | LF | LD | P Value |
|---|---|---|---|
| Onset of sensory block(min) | 15.3+3.3 | 13.5+3.2 | P >0.05 |
| Duration of sensory block (min) | 539.8+48.2 | 748.4+57.2 | 0.000* |
| Onset of motor block (min) | 23.9+3.1 | 22.7+2.4 | P >0.05 |
| Duration of motor block(min) | 560.9+51.3 | 780.7+53.5 | 0.000* |
| Duration of analgesia (min) | 637.2+57.0 | 816.7+55.6 | 0.000* |

Expressed as Mean+ Standard Deviation
*: - significant at 0.01 level

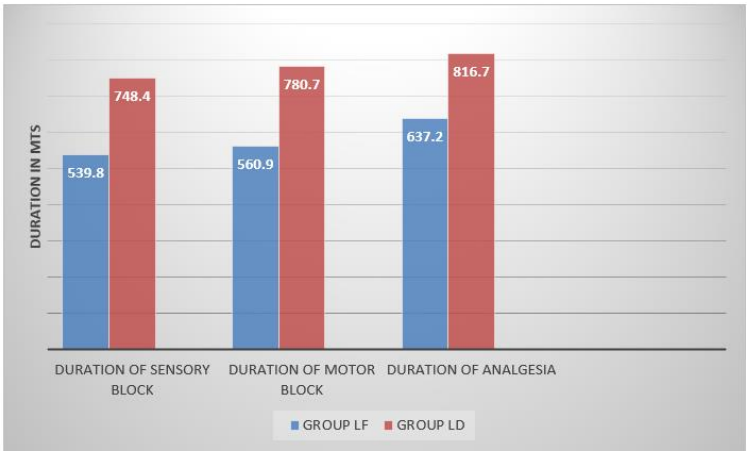


**FIGURE 1: COMPARISON OF BLOCK PARAMETERS**

**TABLE 3: COMPARISON OF PULSE RATE BETWEEN THE GROUP LF AND GROUP LD**

| PULSE RATE | PULSE RATE OF GROUP LF | | GROUP LD | | P value |
|---|---|---|---|---|---|
| | MEAN | SD | MEAN | SD | |
| 5MINS | 85.13 | 7.967 | 84.13 | 7.917 | 0.983 |
| 10MINS | 82.80 | 7.213 | 83.80 | 7.413 | 0.760 |
| 15MINS | 81.93 | 6.291 | 83.93 | 6.517 | 0.976 |
| 20MINS | 80.53 | 7.334 | 79.33 | 7.234 | 0.564 |

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

| | | | | | |
|---|---|---|---|---|---|
| 25MINS | 78.87 | 6.169 | 77.87 | 6.169 | 0.954 |
| 30MINS | 76.53 | 5.606 | 77.67 | 6.326 | 0.636 |
| 60MINS | 81.80 | 6.651 | 82.80 | 6.551 | 0.985 |
| 90MINS | 82.80 | 7.213 | 83.80 | 7.513 | 0.876 |
| 120MINS | 81.80 | 6.651 | 81.60 | 6.751 | 0.897 |

The hemodynamic changes of Pulse rate between both groups were compared in postoperative periods and were not significant respectively. (P> 0.05)

**TABLE 4: COMPARISON OF SYSTOLIC BLOOD PRESSURE BETWEEN THE GROUP LF AND GROUP LD**

| SBP | SYSTOLIC BLOOD PRESSURE | | | | P value |
|---|---|---|---|---|---|
| | GROUP LF | | GROUP LD | | |
| | MEAN | SD | MEAN | SD | |
| 5MINS | 117.33 | 8.277 | 114.67 | 10.080 | 1.120 |
| 10MINS | 117.00 | 8.367 | 116.00 | 9.322 | 0.437 |
| 15MINS | 116.00 | 8.137 | 117.00 | 8.467 | 0.469 |
| 20MINS | 118.00 | 8.867 | 117.00 | 8.357 | 0.449 |
| 25MINS | 118.67 | 8.193 | 117.00 | 8.368 | 0.780 |
| 30MINS | 118.67 | 8.193 | 116.67 | 8.023 | 0.955 |
| 60MINS | 119.00 | 8.847 | 117.00 | 8.367 | 0.900 |
| 90MINS | 119.00 | 8.449 | 118.33 | 7.915 | 0.315 |
| 120MINS | 119.67 | 7.649 | 117.33 | 7.849 | 1.100 |

The hemodynamic changes of systolic blood pressure observed between both groups were compared in postoperative periods and were not significant respectively. (P> 0.05)

**TABLE 5: COMPARISON OF DIASTOLIC BLOOD PRESSURE BETWEEN THE GROUP LF AND GROUP LD**

| DBP | DIASTOLIC BLOOD PRESSURE | | | | P value |
|---|---|---|---|---|---|
| | GROUP LF | | GROUP LD | | |
| | MEAN | SD | MEAN | SD | |
| 5MINS | 79.33 | 7.849 | 81.33 | 7.761 | 0.992 |
| 10MINS | 79.00 | 6.074 | 80.00 | 5.252 | 0.682 |
| 15MINS | 78.67 | 5.713 | 80.00 | 5.252 | 0.941 |
| 20MINS | 79.33 | 5.833 | 81.00 | 4.026 | 1.288 |
| 25MINS | 78.00 | 5.477 | 80.00 | 5.242 | 0.722 |
| 30MINS | 75.00 | 5.724 | 76.33 | 6.145 | 0.869 |
| 60MINS | 75.33 | 6.288 | 76.43 | 6.249 | 0.623 |
| 90MINS | 75.00 | 5.724 | 74.35 | 6.139 | 0.869 |
| 120MINS | 75.67 | 6.261 | 76.40 | 6.149 | 0.416 |

The hemodynamic changes of diastolic blood pressure observed between both groups were compared in postoperative periods and were not significant respectively. (P> 0.05).

**TABLE 6: DISTRIBUTION OF STUDY SUBJECTS BASED ON COMPLICATIONS**

| COMPLICATIONS | GROUP LF | | GROUP LD | |
|---|---|---|---|---|
| | N | % | N | % |

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

| | | | | |
|---|---|---|---|---|
| BRADYCARDIA | 0 | 0 | 0 | 0 |
| SEDATION | 0 | 0 | 1 | 6.7 |
| HYPOTENSION | 1 | 6.7 | 1 | 6.7 |
| NO COMPLICATIONS | 14 | 93.3 | 13 | 86.6 |

In Group LF, the majority of patients (93.3%) experienced no complications, while 6.7% had hypotension. In Group LD, 6.7% of patients experienced sedation, and 6.7% had hypotension.

**DISCUSSION**

The brachial plexus block is a commonly used peripheral nerve blockade for upper limb surgeries. It offers several benefits compared to general anesthesia, including effective pain relief with good motor blockade, keeping the patient awake during the procedure, extended postoperative analgesia, early mobilization, avoidance of airway manipulation, and reduced use of multiple drugs.

Ultrasound-guided supraclavicular blocks have become increasingly popular due to several advantages. The superficial location of the brachial plexus at this level facilitates easy imaging, while the ability to visualize the pleura significantly reduces the risk of pneumothorax. This technique also shortens the time required for block performance and onset, minimizes the number of needle pricks, and lowers the risk of accidental vascular puncture. Additionally, it allows for the use of reduced doses of local anesthetic and improves the overall quality of the nerve block.

Levobupivacaine, the S (-) isomer of bupivacaine, is a newer local anesthetic with lower cardiotoxicity. While it has a similar efficacy to bupivacaine in terms of sensory block onset and duration, it has a better safety profile.

Adjuvants, including opioids and non-opioids, have been studied to enhance brachial plexus blockade. However, there is limited research on the combined use of dexmedetomidine and fentanyl with levobupivacaine, which highlights the need for further investigation in this area.

Dexmedetomidine, a centrally acting α2 agonist, mediates antinociception through peripheral α2 adrenoceptors. Clonidine, another α2 agonist with less selectivity, has also been utilized as an adjuvant to local anesthetics. The likely mechanisms of action of dexmedetomidine include the activation of inwardly rectifying G1 protein-gated potassium channels, leading to membrane hyperpolarization and reduced excitability of CNS cells, as well as a decrease in calcium influx, which inhibits neurotransmitter release. Studies on the addition of dexmedetomidine to bupivacaine and levobupivacaine have demonstrated its effectiveness without any postoperative neurological deficits.

Fentanyl is a powerful synthetic opioid analgesic that acts as a strong agonist at the μ-opioid receptor, characterized by a rapid onset and short duration of action. When combined with local anesthetics in peripheral nerve blocks, fentanyl enhances the anesthetic effect by providing central opioid receptor-mediated analgesia through its peripheral uptake into the systemic circulation.

Marhofer *et al.* investigated the addition of dexmedetomidine as an adjuvant to ropivacaine in an ultrasound-guided ulnar nerve block. Their study demonstrated that while the onset time for the motor block was reduced, there was no impact on the sensory block onset time. Additionally, both sensory and motor block durations were significantly prolonged.

In this study, the duration of sensory and motor blocks was significantly longer ($P < 0.001$) in Group LD compared to Group LF. The extended motor block duration may be

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

attributed to the direct inhibition of excitatory amino acid release from spinal interneurons, aligning with the findings of Agarwal *et al*.[2] Additionally, the duration of analgesia (DOA) in Group II was notably prolonged compared to Group I. This observation is consistent with studies by Esmaoglu *et al.*[14] and Agarwal *et al*, which reported that the addition of 100 µg dexmedetomidine to 0.5% levobupivacaine in an axillary brachial plexus block significantly prolonged the duration of analgesia.

In our study, Sedation and hypotension was seen in one patient in the dexmedetomidine group compared to one patient had hypotension in the fentanyl group. The difference was not statistically significant and clinically did not require any intervention.

In our study, Group LD showed a statistically significant difference in the duration of sensory blockade (748.4 ± 57.2), motor blockade (780.7 ± 53.5), and analgesia (816.7 ± 55.6) compared with Group LF.

## CONCLUSION

Dexmedetomidine, when combined with levobupivacaine for a supraclavicular brachial plexus block, accelerates the onset of both sensory and motor blocks, while significantly prolonging the postoperative analgesic duration compared to fentanyl as an adjuvant to levobupivacaine. This extended analgesic effect minimizes the need for additional pain relief interventions. Additionally, dexmedetomidine offers the benefits of maintaining conscious sedation, ensuring hemodynamic stability, and presenting a minimal risk of adverse effects, making it an invaluable adjuvant for nerve block procedures.

## REFERENCES

1. Hanumanthaiah D, Vaidyanathan S, Garstka M, Szucs S,Iohom G. Ultrasound guided supraclavicular block. MedUltrason 2013;15:224-9.
2. Agarwal S, Aggarwal R, Gupta P. Dexmedetomidine prolongs the effect of bupivacaine in supraclavicular brachial plexus block. J Anaesthesiol ClinPharmacol2014;30:36-40.
3. Marhofer D, Kettner SC, Marhofer P, Pils S, Weber M,Zeitlinger M. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: a volunteer study. Br J Anaesth 2013;110:438-42.
4. Brummett CM, Norat MA, Palmisano JM, Lydic R. Perineural administration of dexmedetomidine in combination with bupivacaine enhances sensory and motor blockade in sciatic nerve block without induced neurotoxicity in rat. Anaesthesiology 2008;109:502-11.
5. Gandhi R, Shah A, Patel I. Use of dexmedetomidine along with bupivacaine for brachial plexus block. Natl JMed Res 2012;2:67-9.
6. Almarakbi WA, Kaki AM. Addition of dexmedetomidine to bupivacaine in transversus abdominis plane block potentiates post-operative pain relief among abdominal hysterectomy patients: A prospective randomized controlled trial. Saudi J Anaesth 2014;8:161-6.
7. Malenfant Rancourt MP, Albert NT, Côté M, LétourneauD-R, Bernard P-M. Posterior tibial nerve sensory blockade duration prolonged by adding dexmedetomidine to ropivacaine. Anesth Analg 2012;115:958-62.
8. Lin Y-N, Li Q, Yang R-M, Mao Z-X, Liu J-C. Addition of dexmedetomidine to ropivacaine improves cervical plexus block. Acta Anaesthesiologica Taiwanica 2013;51:63-6.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

9. Kwon Y, Hwang SM, Lee JJ, Kim JH. The effect of dexmedetomidine as an adjuvant to ropivacaine on the bispectral index for supraclavicular brachial plexus block. Korean J Anesthesiol 2015;68:32-6.
10. Kaygusuz K, Kol IO, Duger C, *et al.* Effects of adding dexmedetomidine to levobupivacaine in axillary brachial plexus block. Curr Ther Res Clin Exp 2012;73:103-11.
11. Obayah GM, Refaie A, Aboushanab O, Ibraheem N,Abdelazees M. Addition of dexmedetomidine to bupivacaine for greater palatine nerve block prolongs postoperative analgesia after cleft palate repair. Eur J Anaesthesiol 2010;27:280-4.
12. Zhang Y, Wang C-S, Shi J-H, *et al.* Perineural administration of dexmedetomidine in combination with ropivacaine prolongs axillary brachial plexus block. Int JClin Exp Med 2014;7:680-5.
13. Sudheesh K, Harsoor SS. Dexmedetomidine in anaesthesia practice: A wonder drug? Indian J Anaesth2011;55:323-4.
14. Esmaoglu A, Yegenoglu F, Akin A, Turk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. Anesth Analg2010;111:548-51.
15. Biswas S, Das RK, Mukherjee G, Ghose Dexmedetomidine an adjuvant to levobupivacaine in supraclavicular brachial plexus block: A randomized double blind prospective study. Ethiop J