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Original article

Comparative evaluation of Levobupivacaine alone and Levobupivacaine with Dexmedetomidine as an adjuvant in Brachial plexus block for upper arm surgery

[1]Dr Rahul Ranjan Gupta*, [2]Dr Sparsh Arora, [3]Dr Gagandeep Kaur, [4]Dr Raj Krishna Shrivastava

[1]PG resident, At KNS-MIMS, Barabanki, Uttar Pradesh
[2] PG resident, Lady Hardinge Medical College, Delhi
[3] Consultant, Max Superspecialty Hospital, Mohali, Punjab.
[4] Professor and HOD , Department of Anesthesiology, KNS-MIMS, Barakanki, Uttar Pradesh
*Corresponding author**

Abstract

Background: *Brachial plexus block (BPB) provides effective analgesia for upper limb surgeries. Levobupivacaine, a long-acting local anesthetic, is commonly used in BPB. This study aims to compare the efficacy and safety of Levobupivacaine alone versus Levobupivacaine with Dexmedetomidine as an adjuvant.*

Methods: *In this prospective, randomized controlled trial, adult patients (18-65 years) undergoing elective upper arm surgeries were divided into two groups: Group B (Levobupivacaine alone) and Group D(Levobupivacaine with Dexmedetomidine). The BPB was performed using an ultrasound-guided technique. Primary outcomes included duration of analgesia, Visual Analog Scale (VAS) scores for analgesia, hemodynamic parameters, and sedation levels.*

Results: *Group D showed a significantly longer duration of analgesia (565.2 ± 38.6 minutes) compared to Group B (243.7 ± 42.9 minutes) ($p < 0.05$). VAS scores were significantly better in Group D, with 90% reporting good analgesia versus 44% in Group B. Hemodynamic stability was similar in both groups, while sedation scores were higher in Group D, particularly in light and deep sedation categories.*

Conclusion: *The combination of Levobupivacaine and Dexmedetomidine in BPB enhances the duration and quality of analgesia without compromising hemodynamic stability, offering potential benefits for postoperative pain management in upper arm surgeries.*

Keywords: *Levobupivacaine, Dexmedetomidine, Brachial Plexus Block*

Introduction:

Brachial plexus block has emerged as a cornerstone in regional anesthesia for upper limb surgeries, offering effective analgesia and minimizing the need for systemic opioids.[(1)] Levobupivacaine, a long-acting amide local anesthetic, has gained popularity for its favorable pharmacokinetic profile, providing prolonged duration of sensory and motor blockade while minimizing the risk of systemic toxicity.[(2)] In recent years, researchers and clinicians have explored the potential enhancement of brachial plexus block outcomes by incorporating adjuvants to the local anesthetic solution.[(3)]

Among the various adjuvants, dexmedetomidine, a highly selective alpha-2 adrenergic agonist, has demonstrated promise in augmenting the effects of regional anesthesia. [(4,5)] Dexmedetomidine possesses analgesic and sedative properties without causing significant respiratory depression, making it an attractive choice for adjuvant therapy in regional anesthesia. The combination of levobupivacaine with dexmedetomidine has been investigated for its potential to extend the duration of analgesia, improve block quality, and enhance patient satisfaction in upper arm surgeries.[(6)] This comparative evaluation seeks to critically examine and compare the outcomes of levobupivacaine alone versus levobupivacaine with dexmedetomidine as an adjuvant in brachial plexus block for upper arm surgeries.

Methodology:

This prospective, randomized controlled trial (RCT) was conducted over two years in the Department of Anesthesiology. Adult patients aged 18 to 65 years scheduled for elective upper arm surgeries and classified as American Society of

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Anesthesiologists (ASA) physical status I or II were included in the study. Exclusion criteria encompassed patients with known allergies to levobupivacaine or dexmedetomidine, significant cardiovascular, respiratory, or neurological diseases, pregnancy or lactation, coagulation disorders, and pre-existing brachial plexus injury or neuropathy. Participants who met the inclusion criteria were randomly assigned to one of two groups: Group A, receiving levobupivacaine alone, and Group B, receiving levobupivacaine with dexmedetomidine.

The intervention for Group A involved performing a brachial plexus block using 0.5% levobupivacaine, tailored to the patient's weight and the requirements of the surgical procedure. For Group B, the brachial plexus block was conducted using a combination of 0.5% levobupivacaine and dexmedetomidine (1 µg/kg), also adjusted according to the patient's weight. An ultrasound-guided technique was employed to administer the brachial plexus block, performed by an experienced anesthesiologist. Standard monitoring protocols were followed, including continuous electrocardiography (ECG), non-invasive blood pressure, and pulse oximetry, with supplemental oxygen provided via nasal cannula.

Data collection was performed by an independent researcher not involved in patient care.

Randomization was implemented for consenting patients, assigning them to either Group B (levobupivacaine alone) or Group D (levobupivacaine with dexmedetomidine).

Results:

In this comparative study, the combination of Dexmedetomidine and Levobupivacaine (Group D) was administered alongside Levobupivacaine alone (Group B) for anesthesia across different age groups. The data suggests that Group D exhibited slightly higher frequencies in the 30-39 and 40-49 age brackets compared to Group B, potentially indicating a preference or efficacy of the combined medication in these age ranges.

Table 1: Duration of Analgesia

Duration (minutes)	**Group D (Mean ± SD)**	**Group B (Mean ± SD)**	**Independent samples t-test.**
565.2 ± 38.6	565.2 ± 38.6	243.7 ± 42.9	Statistically significant ($p < 0.05$).

Table 2: VAS Score for Analgesia

VAS Score	**Group D (Number (%))**	**Group B (Number (%))**	**Chi square test**	**Result**
Good	45 (90%)	22 (44%)	6.42	Significant difference
Moderate	5 (10%)	20 (40%)	7.30	Significant difference
Poor	0 (0%)	8 (16%)	2.94	Significant difference

A Chi-square test was conducted to compare the distribution of Visual Analog Scale (VAS) scores between Group D (Dexmedetomidine + Levobupivacaine) and Group B (Levobupivacaine alone). The analysis revealed significant differences in VAS scores between the two groups across all categories: Good ($p = 6.42$), Moderate ($p = 7.3$), and Poor ($p = 2.94$). These findings suggest that the use of Dexmedetomidine alongside Levobupivacaine (Group D) may result in significantly different pain perception outcomes compared to Levobupivacaine alone (Group B).

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Table 3: Hemodynamic Parameters (Heart Rate)

Time (minutes)	Group D (Mean ± SD)	Group B (Mean ± SD)	Independent samples t-test
1	78.4 ± 4.6	80.2 ± 5.2	Significant difference
5	76.8 ± 4.2	79.6 ± 4.8	Significant difference
10	75.2 ± 4.1	78.3 ± 4.5	Significant difference
30	74.5 ± 3.9	77.1 ± 4.2	Significant difference

Table 4: Hemodynamic Parameters (Blood Pressure)

Time (minutes)	**Group D (Mean ± SD)**	**Group B (Mean ± SD)**	**Independent samples t-test**
1	120/70 ± 8/5	122/72 ± 9/6	Significant difference
5	118/68 ± 7/4	120/70 ± 8/5	Significant difference
10	116/66 ± 7/4	118/68 ± 7/4	Significant difference
30	115/65 ± 6/3	117/67 ± 7/4	Significant difference

Table 5: Sedation Scores

Sedation Level	**Group D (Mean ± SD)**	**Group B (Mean ± SD)**	**t-test of significance**	**Result**
Light	2.1 ± 0.4	1.8 ± 0.5	3.31	Significant
Moderate	1.4 ± 0.3	1.3 ± 0.4	1.41	Non-significant
Deep	0.5 ± 0.2	0.3 ± 0.1	6.31	Significant

Discussion:

The choice of local anesthetic and adjuvants significantly impacts the quality and duration of block, influencing postoperative pain control and patient satisfaction. Levobupivacaine, a long-acting amide local anesthetic, has gained popularity due to its favorable pharmacokinetic profile and reduced cardiotoxicity compared to its racemic counterpart, bupivacaine. However, the quest for enhancing block characteristics while minimizing adverse effects has led to the exploration of adjuvants like dexmedetomidine.(43) Our study aims to assess the efficacy, safety, and duration of sensory and motor blockade achieved with these two regimens, shedding light on their clinical utility and potential advantages in perioperative pain management. [7,8]

A t-test of significance was conducted to compare the mean sedation levels between Group D (Dexmedetomidine + Levobupivacaine) and Group B (Levobupivacaine alone) across different categories. Significant differences were found in the Light and Deep sedation levels, with Group D

showing higher mean scores compared to Group B. However, there was no significant difference observed in the Moderate sedation level between the two groups. These results suggest that the combination of Dexmedetomidine and Levobupivacaine may lead to increased sedation levels, particularly in the Light and Deep categories, compared to Levobupivacaine alone.

The study also assessed hemodynamic parameters and sedation levels during the intraoperative and postoperative periods. Dexmedetomidine is known for its sedative and sympatholytic effects, which can lead to bradycardia and hypotension, particularly at higher doses. However, in this study, there were no significant differences in hemodynamic parameters between Group D and Group B, indicating comparable hemodynamic stability.

Furthermore, the sedation scores were higher in Group D compared to Group B, particularly in the Light and Deep sedation categories. This finding suggests that the addition of dexmedetomidine may result in increased sedation levels, potentially enhancing patient comfort and reducing perioperative anxiety. However, it is essential to note that while sedation can be beneficial in certain scenarios, excessive sedation may interfere with patient monitoring and recovery, necessitating careful titration of dexmedetomidine doses based on individual patient factors and surgical requirements.[12,13,14]

The findings of this study have several clinical implications for the practice of regional anesthesia in upper arm surgeries. The combination of dexmedetomidine and levobupivacaine appears to offer advantages in terms of faster onset times, prolonged duration of blocks, and potentially enhanced intraoperative efficiency. These benefits could translate to improved patient outcomes, including better pain control, reduced opioid consumption, and enhanced postoperative recovery.

In conclusion, the combination of dexmedetomidine and levobupivacaine represents a promising approach to enhance the efficacy and safety of BPB for upper arm surgeries. Further research is needed to elucidate the optimal use of dexmedetomidine as an adjuvant in regional anesthesia and its long-term effects on patient outcomes.

When compared to levobupivacaine alone, Dexmedetomidine showed faster onset times and longer duration of sensory and motor blocks with better and prolonged Analgesia. Sedation levels were higher in group in which dexmedetomidine was added, with no recorded case of respiratory depression. Also, shorter hospital stays and less use of Non-Steroidal Anti-inflammatory Drugs (NSAIDS) and opioids for patients of group D was reported indicating its potential for use in Ambulatory or day care surgeries.

Similar patient demographic distributions have been reported in studies like those by Kaur et al., Singh AP et al., and Ghazaly HF et al., which helps validate the consistency and reliability of our demographic data. The extended duration of sensory and motor blockages in Group D highlights the clinical significance of Dexmedetomidine as an adjuvant in Brachial Plexus Block for surgeries involving the upper limb. This can lead to decreased postoperative pain, reduced opioid consumption, and enhanced patient satisfaction.

The extended duration of blocks also contributes to improved rehabilitation outcomes and faster recovery, allowing early ambulation and resumption of daily activities. Adverse events like bradycardia, hypotension, was observed initially (in 5, and 10 minutes after administration) in group D, which however returned within the normal range and patient was stabilized hemodynamically after a few minutes (within 15-20 minutes). No cases of respiratory depression, was noted in either two groups.

• In Group B, the sedation was less and patient was more anxious. So rescue analgesic like NSAID and opioids had to be given peroperatively and postoperatively.

• As stated earlier, the analgesia was not sufficient as indicated by the (Visual Analog Score) VAS scores of patients under group B and rescue analgesic like NSAID and opioid had to be administered. On comparing, patients in group D had better analgesic effect and was calm peroperatively and rarely required post operative analgesia.

In conclusion, the combination of Dexmedetomidine and Levobupivacaine represents a promising approach to enhance the efficiency and safety of Brachial Plexus Block for upper limb surgeries. Further investigation is needed to explain the optimal application of Dexmedetomidine as an adjuvant in regional Anaesthesia and its long-term effects on patient outcomes.

The study did not address the potential cost implications of using Dexmedetomidine as an adjuvant in Brachial Plexus Block (SupraClavicular Block). The study did not determine the optimal dosing for the best result for peripheral nerve blocks using Dexmedetomidine as an adjuvant. Finally, it is concluded that Dexmedetomidine as an adjuvant in Brachial Plexus Block shows promise for enhancing the efficiency of local anaesthesia for postoperative pain control in upper limb surgeries. It reduces the need for post operative analgesia as well as increase the duration of block and significantly reduces the onset of sensory and motor block (Sensory>Motor).

Though the incidence of respiratory 12 depression is mentioned in literature, yet, no respiratory depression was observed in any of my patients. However, to validate these results and for the best dosing strategies, more research is required for proper dosing and long-term effect of the drug.

Conclusion:

The combination of dexmedetomidine and levobupivacaine in brachial plexus block for upper arm surgeries showed promising results in terms of anesthesia efficacy and safety. Dexmedetomidine contributed to faster onset times of sensory and motor blocks, potentially facilitating smoother intraoperative procedures. This study evaluates the efficacy and safety of Dexmedetomidine as an adjuvant in Brachial Plexus Block for upper limb surgeries compared to levobupivacaine alone.

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