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Comparative Evaluation Of Levobupivacaine Alone And Levobupivacaine With Dexmedetomidine As An Adjuvant For Upper Limb Surgeries.

Rahul Ranjan Gupta[1]*, Atul Kumar Singh Patel[2], and Umesh Kumar Sharma[3].

[1]PG Resident, Dept. Of Anesthesiology, Dr KNS Memorial Institute of Medical Science, Barabanki, Uttar Pradesh, India.
[2]Assistant Professor, Dept. Of Anesthesiology, Dr KNS Memorial Institute of Medical Science, Barabanki, Uttar Pradesh, India.
[3]Assistant Professor, Dept. Of Anesthesiology, Dr KNS Memorial Institute of Medical Science, Barabanki, Uttar Pradesh, India.

ABSTRACT

This study evaluates the efficacy and safety of dexmedetomidine as an adjuvant in brachial plexus block (BPB) for upper arm surgeries compared to levobupivacaine alone. A prospective, randomized controlled trial was conducted over two years within the Department of Anesthesiology. Adult patients scheduled for elective upper arm surgeries were randomized into two groups: Group D received dexmedetomidine and levobupivacaine, while Group B received levobupivacaine alone. Primary outcomes included duration of sensory and motor blocks, with secondary outcomes encompassing analgesic consumption, pain scores, hemodynamic parameters, and adverse events. Dexmedetomidine demonstrated faster onset times and prolonged duration of sensory and motor blocks compared to levobupivacaine alone. However, analgesic consumption and pain scores did not significantly differ between groups. Hemodynamic stability was maintained with dexmedetomidine, and sedation levels were higher compared to levobupivacaine alone. Dexmedetomidine as an adjuvant in BPB shows promise for enhancing anesthesia efficacy and postoperative pain control for upper arm surgeries. Further research is needed to validate these findings in larger cohorts and explore optimal dosing strategies.
Keywords: Dexmedetomidine, brachial plexus block, upper arm surgery.

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Corresponding author

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INTRODUCTION

The choice of local anesthetic and adjuvants significantly impacts the quality and duration of block, influencing postoperative pain control and patient satisfaction [1]. 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 [2-4].

The comparative evaluation of levobupivacaine alone versus levobupivacaine with dexmedetomidine as an adjuvant in BPB for upper arm surgery is crucial for optimizing anesthesia techniques and improving patient outcomes.

Dexmedetomidine, a highly selective α2-adrenergic agonist, exhibits potent analgesic properties and synergistic effects with local anesthetics, prolonging the duration and enhancing the quality of peripheral nerve blocks [5].

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.

METHODOLOGY

The study employed a prospective, randomized controlled trial (RCT) design over a period of two years within the Department of Anesthesiology. Adult patients aged between 18 to 65 years, scheduled for elective upper arm surgeries, and classified under American Society of Anesthesiologists (ASA) physical status I or II were considered for inclusion. 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.

Randomization allocated eligible patients into one of two groups: Group A received levobupivacaine alone, while Group B received levobupivacaine with dexmedetomidine. Brachial plexus block procedures were conducted accordingly, with Group A administered 0.5% levobupivacaine and Group B receiving a combination of 0.5% levobupivacaine and dexmedetomidine (1 μg/kg), both guided by ultrasound technique and adjusted based on patient weight and surgical requirements.

Standard monitoring, including continuous electrocardiography (ECG), non-invasive blood pressure, and pulse oximetry, was employed throughout the procedures. Supplemental oxygen via nasal cannula was provided, and data collection was executed by an independent researcher not involved in patient care. Key outcome measures included the duration of sensory and motor blocks, analgesic consumption within the first 24 hours postoperatively, patient-reported pain scores using a numerical rating scale (NRS), hemodynamic parameters, and the incidence of adverse events.

Data analysis encompassed rigorous statistical methods, employing appropriate tests such as Student's t-test or Mann-Whitney U test for continuous variables and chi-square or Fisher's exact test for categorical variables. Subgroup analyses were considered based on surgery type or patient demographics, with a significance threshold set at $p < 0.05$. The study aimed to elucidate the comparative efficacy of levobupivacaine alone versus levobupivacaine with dexmedetomidine in brachial plexus blocks for upper arm surgeries.

RESULTS

In the comparison between Group D (Dexmedetomidine + Levobupivacaine) and Group B (Levobupivacaine alone) based on ASA (American Society of Anesthesiologists) grade, the Chi-square test was conducted. For ASA grade 1, there were 40 participants in Group D and 42 participants in Group B, yielding a chi-square value of 0.27, which was not statistically significant. Similarly, for ASA grade 2, Group D had 10 participants and Group B had 8 participants, though the statistical significance was not provided.

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Table 1: ASA Grade Distribution

ASA Grade	Group D (Dexmedetomidine + Levobupivacaine)	Group B (Levobupivacaine alone)	Chi – square Test
ASA 1	40 (80%)	42 (84%)	0.270
ASA 2	10 (20%)	8 (16%)	Non- significant

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).

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

An independent samples t-test was employed to compare the mean time in minutes for achieving various milestones during surgical procedures between Group D (Dexmedetomidine + Levobupivacaine) and Group B (Levobupivacaine alone). Across all time points (1, 5, 10, and 30 minutes), significant differences were observed, indicating that Group D consistently exhibited shorter durations compared to Group B. This suggests that the combination of Dexmedetomidine and Levobupivacaine may lead to more efficient anesthesia induction and procedural progress.

DISCUSSION

Brachial plexus block (BPB) has become a preferred technique for upper extremity surgeries due to its effectiveness in providing anesthesia and postoperative pain relief. This prospective, randomized controlled trial aimed to compare the efficacy and safety of levobupivacaine alone versus a combination of levobupivacaine and dexmedetomidine as an adjuvant in BPB for upper arm surgeries. The study encompassed various aspects, including patient demographics, surgical characteristics, onset times, duration of blocks, analgesic consumption, pain scores, hemodynamic parameters, and sedation levels [6-8].

Patient Demographics and Characteristics

Our study enrolled adult patients aged 18 to 65 years scheduled for elective upper arm surgeries with ASA physical status I or II. The distribution of patients across different age groups and genders was relatively balanced between Group D (dexmedetomidine + levobupivacaine) and Group B (levobupivacaine alone), ensuring comparability and minimizing confounding factors related to

demographics. Additionally, the ASA grade distribution was similar between the two groups, indicating comparable preoperative health statuses [9].

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. The mean age of participants in Group D (Dexmedetomidine + Levobupivacaine) was 35.32 years with a standard deviation of 7.22, while in Group B (Levobupivacaine alone), it was 36.38 years with a standard deviation of 7.38. The t-test yielded a p-value of 0.726, indicating non-significance and suggesting that there is no statistically significant difference in age between the two groups.

In this study comparing the administration of Dexmedetomidine + Levobupivacaine (Group D) versus Levobupivacaine alone (Group B) for anesthesia, the distribution of gender between the two groups was relatively balanced. Group D comprised 23 males and 27 females, while Group B had 24 males and 26 females. This balanced gender distribution helps mitigate potential confounding effects related to gender in the analysis of the study's outcomes.

In the comparison between Group D (Dexmedetomidine + Levobupivacaine) and Group B (Levobupivacaine alone) based on ASA (American Society of Anesthesiologists) grade, the Chi-square test was conducted. For ASA grade 1, there were 40 participants in Group D and 42 participants in Group B, yielding a chi-square value of 0.27, which was not statistically significant. Similarly, for ASA grade 2, Group D had 10 participants and Group B had 8 participants, though the statistical significance was not provided.

In the comparison between Group D (Dexmedetomidine + Levobupivacaine) and Group B (Levobupivacaine alone) regarding the type of surgical procedures performed, a Chi-square test was conducted. For shoulder surgery, 25 participants were in Group D and 24 participants were in Group B, however, the statistical significance was not provided. Conversely, for elbow surgery, Group D had 15 participants and Group B had 16 participants, with a chi-square value of 0.027, indicating a statistically significant difference. No significant difference was observed between the two groups for wrist surgery.

The duration of surgery, measured in minutes, was compared between Group D (Dexmedetomidine + Levobupivacaine) and Group B (Levobupivacaine alone) using an independent samples t-test. The mean duration of surgery was 85.6 minutes with a standard deviation of 15.2 in Group D, and 87.4 minutes with a standard deviation of 14.6 in Group B. The t-test revealed a statistically significant difference ($p < 0.05$), indicating that surgeries in Group D were, on average, shorter in duration compared to Group B.

The administration of dexmedetomidine alongside levobupivacaine (Group D) was associated with several notable findings regarding surgical characteristics. Firstly, there was a significant difference in the duration of surgeries between Group D and Group B, with surgeries in Group D being shorter on average. This observation suggests that the addition of dexmedetomidine may contribute to more efficient procedural progress, potentially due to its analgesic and sedative properties, which could facilitate surgical maneuvers and reduce intraoperative complications.

The results present the mean ± standard deviation (SD) time in minutes for achieving different milestones during the surgical procedure in Group D (Dexmedetomidine + Levobupivacaine) and Group B (Levobupivacaine alone). Across all time points (1, 5, 10, and 30 minutes), Group D consistently demonstrated shorter durations compared to Group B, suggesting potentially more efficient anesthesia induction and procedural progress with the combination medication.

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 [10].

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.

CONCLUSION

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.

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