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Original Article

COMPARISON OF CLONIDINE AND DEXMEDETOMIDINE AS ADJUVANTS TO LEVOBUPIVACAINE FOR SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPER LIMB SURGERY UNDER ULTRASOUND GUIDANCE

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ABSTRACT

Objective: The addition of adjuvants to local anesthetics can significantly improve the efficacy of regional blocks. This study compares the effectiveness of Clonidine and Dexmedetomidine as adjuvants to Levobupivacaine in a supraclavicular brachial plexus block for upper limb surgeries.

Methods: This observational comparative study included 68 patients, divided into two groups to receive either Dexmedetomidine or Clonidine with Levobupivacaine. The onset and duration of the sensory block and the time to first rescue analgesia were evaluated.

Results: Dexmedetomidine demonstrated a slightly faster onset and a significantly longer duration of sensory block and analgesia compared to Clonidine. Both drugs were well-tolerated without significant adverse effects.

Conclusion: Dexmedetomidine surpasses Clonidine in prolonging the effects of Levobupivacaine in supraclavicular brachial plexus blocks, suggesting its advantageous use in clinical settings for extended analgesia.

Keywords: Dexmedetomidine, Clonidine, Levobupivacaine, Supraclavicular brachial plexus block, Regional anesthesia, Adjuvants

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INTRODUCTION

The efficacy of regional anesthesia can be significantly enhanced by the addition of adjuvants to local anesthetics, which prolong analgesia, improve block quality, and reduce the requirements for opioids postoperatively. In upper limb surgeries, a supraclavicular brachial plexus block is a preferred method due to its rapid onset and comprehensive anesthetic coverage. This technique is particularly beneficial under ultrasound guidance, which improves the accuracy of local anesthetic placement and potentially reduces complications. Among various adjuvants, Clonidine and Dexmedetomidine have emerged as effective enhancers of local anesthetic action due to their distinct mechanisms involving α2-adrenergic receptor agonism [1-3].

Clonidine, an α2-adrenergic agonist, has been widely used in peripheral nerve blocks to prolong the duration of analgesia. Its analgesic properties are mediated through the reduction of the release of nociceptive neurotransmitters and the modulation of pain signals at the spinal cord level. By adding Clonidine to local anesthetics, the duration of blocks can be extended, which is beneficial for postoperative pain management without the systemic side effects associated with higher doses of opioids [3-5].

Dexmedetomidine, a more selective α2-adrenergic receptor agonist compared to Clonidine, offers similar benefits but with potentially fewer side effects due to its higher selectivity. Studies have shown that Dexmedetomidine, when used as an adjuvant in brachial plexus blocks, not only prolongs the duration of analgesia but also enhances the quality of the sensory and motor block. The drug's sedative properties, which do not significantly impact respiratory function, make it an advantageous choice in outpatient surgery settings where rapid recovery and discharge are desired [6-8].

The application of these adjuvants in conjunction with Levobupivacaine, a long-acting local anesthetic, offers an ideal combination for effective, prolonged analgesia in upper limb surgeries. Levobupivacaine, known for its reduced cardiotoxicity compared to Bupivacaine, ensures a safer profile for patients, particularly those with underlying cardiovascular conditions. The integration of ultrasound guidance in administering the supraclavicular brachial plexus block further optimizes drug delivery, minimizes local anesthetic systemic toxicity, and enhances patient safety [9].

This study aims to compare the effectiveness of Clonidine and Dexmedetomidine as adjuvants to Levobupivacaine in the context of supraclavicular brachial plexus blocks for upper limb surgeries. By focusing on the onset of action, duration of analgesia, patient comfort, and any adverse effects, the study endeavors to delineate which adjuvant may offer superior enhancement of the anesthetic profile of Levobupivacaine. Through this comparison, the research will contribute valuable insights into optimizing regional anesthesia protocols, with potential implications for enhancing patient outcomes in perioperative pain management.

MATERIALS AND METHODS

Study setting

This observational comparative study was conducted at the Department of Anesthesiology, Jaipur National University Institute of Medical Sciences and Research Centre, Jaipur, Rajasthan.

Study design

An observational and comparative approach was employed from September 2022 to February 2024.

Sample size determination

The study included a total of 68 patients, divided into two groups of 34 each. Group A was administered 1 µg/kg body weight of Dexmedetomidine, and Group B received 1 µg/kg body weight of Clonidine, both adjunct to 0.5% Levobupivacaine. The sample size was calculated based on previous literature, aiming for a 95% confidence interval and a 5% margin of error.

Inclusion criteria

- Patients aged 18-55 y.
- American Society of Anesthesiologists (ASA) Grade I and II.

- Written informed consent from participants.

Exclusion criteria

- Patients with contraindications to regional anesthesia, such as central or peripheral nervous system disorders, coagulopathy, or site infection.
- Allergies to any study medications.
- Inability to cooperate with study procedures.

Methodological approach

Eligible patients either attended the outpatient department or were admitted for elective upper limb surgeries. A standardized proforma was used for detailed histories, clinical examinations, and necessary laboratory tests, including complete blood counts, blood group typing, fasting blood glucose, renal and liver function tests, coagulation profiles, and diagnostic imaging like chest X-rays and ECGs.

Ethical considerations

Approval was obtained from the institutional ethical committee prior to study initiation. Informed consent was acquired from all participants, ensuring confidentiality and voluntary participation with no additional risk.

Anesthetic procedure

Patients underwent fasting from midnight and received premedication with ranitidine and alprazolam on the day of surgery. An ultrasound-guided supraclavicular brachial plexus block was performed under optimal positioning. Monitoring during the procedure included non-invasive blood pressure, ECG, and pulse oximetry. The block was executed with 0.5% Levobupivacaine mixed with the assigned adjuvants, totaling 30 ml for each patient.

Postoperative assessment

Sensory and motor blocks were evaluated using a three-point scale, and pain was monitored using the Numeric Rating Scale (NRS). The duration of analgesia was noted until a pain score exceeding 4 necessitated rescue analgesia with intravenous Diclofenac. Sedation levels were assessed using the Ramsay Sedation Scale, and complications like nausea, pruritus, and respiratory depression were recorded and managed accordingly.

Statistical analysis

Data were inputted into Microsoft Excel and analyzed using SPSS version 25. Quantitative data were presented as means±SD or medians with interquartile ranges, while qualitative data were shown as percentages. Associations between variables were tested using appropriate statistical tests with a significance level set at $p<0.05$.

Equipment and monitoring

Essential equipment included a multi-parameter monitor, premedication drugs, Hudson's mask, Bain's circuit, laryngoscope, and various sizes of endotracheal tubes, among others. All necessary resuscitative equipment was available on standby.

Funding and disclosure

The study did not receive external funding and was conducted as part of routine investigations.

RESULTS

The study included a total of 68 patients undergoing upper limb surgeries, where each of the two groups-dexmedetomidine and clonidine-comprised 34 patients, accounting for 50% of the study population each. The distribution of patients based on the American Society of Anesthesiologists (ASA) physical status classification showed that in the dexmedetomidine group, 55.9% (n=19) were classified as ASA I and 44.1% (n=15) as ASA II. Similarly, in the Clonidine group, 52.9% (n=18) were ASA I and 47.1% (n=16) were ASA II.

The onset of sensory block, measured in minutes, demonstrated a slightly faster onset for the dexmedetomidine group with a mean time of 6.23±1.54 min compared to the Clonidine group, which had a mean onset time of 6.56±1.60 min. The difference, however, did not reach statistical significance ($\chi^2=3.47$, $p=0.06$), suggesting comparable efficacy in the initial phase of anesthesia between the two adjuvants.

Significant differences were observed in the duration of the sensory block. Patients in the dexmedetomidine group experienced a longer duration of sensory block, averaging 11.21±0.24 h, compared to those in the Clonidine group, who had a block duration of 10.27±0.29 h ($p=0.01$). This indicates a superior prolongation of sensory anesthesia with dexmedetomidine when used as an adjuvant to levobupivacaine.

Furthermore, the time to first rescue analgesia also highlighted a notable advantage for dexmedetomidine. The mean time was 11.84±0.29 h for dexmedetomidine, versus 10.91±0.34 h for Clonidine, with the difference being statistically significant ($p=0.01$). This suggests that dexmedetomidine not only enhances the quality of the block but also effectively extends the analgesic duration post-surgery.

In summary, both dexmedetomidine and clonidine significantly improve the anesthetic and analgesic qualities of levobupivacaine in supraclavicular brachial plexus blocks. However, dexmedetomidine exhibits a statistically significant advantage in prolonging both the sensory block duration and the duration of postoperative analgesia, supporting its preferential use as an adjuvant in clinical settings where extended analgesia is beneficial.

Table 1: Descriptive statistics of study groups

Group	Number of patients (n)	Percentage (%)
Dexmedetomidine	34	50
Clonidine	34	50
Total	68	100

Table 2: Asa status distribution among study groups

ASA status	Dexmedetomidine n (%)	Clonidine n (%)
I	19 (55.9)	18 (52.9)
II	15 (44.1)	16 (47.1)
Total	34 (100)	34 (100)

Table 3: Onset of sensory block among groups

Parameter	Dexmedetomidine (Mean±SD)	Clonidine (Mean±SD)	2 □, p-value
Onset of Sensory Block (in minutes)	6.23±1.54	6.56±1.60	3.47, 0.06

Table 4: Duration of sensory block among groups

Parameter	Dexmedetomidine (Mean±SD)	Clonidine (Mean±SD)	p-value LD vs. LC
Duration of Sensory Block (in hours)	11.21±0.24	10.27±0.29	0.01

Table 5: Time of first rescue analgesia among groups

Parameter	Dexmedetomidine (Mean±SD)	Clonidine (Mean±SD)	p-value LD vs. LC
Time of first rescue analgesia (in hours)	11.84±0.29	10.91±0.34	0.01

DISCUSSION

The results from this study highlight the benefits of using α2-adrenergic receptor agonists as adjuvants in regional anesthesia for upper limb surgeries. Dexmedetomidine and Clonidine, when used with Levobupivacaine, enhance the block's efficacy, yet Dexmedetomidine shows a superior duration of sensory block and extended time until first rescue analgesia. This could be attributed to Dexmedetomidine's higher receptor selectivity, which may result in a more potent and targeted modulation of pain pathways. Studies have demonstrated that Dexmedetomidine, due to its high α2:α1 ratio, provides a more stable and prolonged sympathetic blockade compared to Clonidine, which may explain the differences observed in sensory block duration and analgesia duration in this study [10-12].

Moreover, the safety profile of both drugs was upheld as no significant adverse effects requiring intervention were reported, aligning with previous research that suggests these adjuvants do not significantly increase the risk of side effects when used in clinically appropriate doses. The slight difference in onset times, although not statistically significant, could suggest a more rapid integration of Dexmedetomidine into the local anesthetic matrix, potentially due to its pharmacokinetic properties [13, 14].

Future research should focus on optimizing dosages and combinations with different local anesthetics to further enhance the clinical utility of these adjuvants. Additionally, exploring patient-centered outcomes, such as satisfaction and recovery times, could provide deeper insights into the practical benefits of each adjuvant in clinical anesthesia practice.

CONCLUSION

This study confirms that both Clonidine and Dexmedetomidine significantly improve the quality and duration of anesthesia when used as adjuvants to Levobupivacaine in supraclavicular brachial plexus blocks for upper limb surgery. Dexmedetomidine, in particular, provides a longer duration of sensory block and extends the analgesic effect significantly more than Clonidine. These findings support the preferential use of Dexmedetomidine for surgeries where prolonged postoperative analgesia is beneficial, contributing to enhanced patient comfort and reduced need for opioid analgesics.

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AUTHORS CONTRIBUTIONS

All authors have contributed equally

CONFLICT OF INTERESTS

Declared none

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