

A comparative study between Dexmedetomidine-levobupivacaine combination with Dexmedetomidine-ropivacaine used in supraclavicular brachial plexus block in upper limb orthopaedic surgeries

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I. Introduction

Brachial plexus block has evolved as an important tool in the anesthesiologist's armamentarium as a safe alternative to general anesthesia for upper limb surgery and for relief of perioperative pain. Its increased popularity is because of advancements in regional anesthesia techniques in terms of local anesthetic drugs, newer adjuvant drugs and use of ultrasound for safe and successful conduct of block. It helps in reduced hospital stay, less financial burden and also leads to avoidance of undesirable side-effects of general anesthesia.(1)

Since the introduction of first brachial plexus block using cocaine by Halstead (1884) the technique of brachial plexus block has evolved from classical blind technique to use of nerve stimulators and ultrasound guidance for supraclavicular brachial plexus block.(2)

Considerable research has been conducted over years in order to determine the ideal local anesthetic (LA) drug. An ideal drug should have a fast sensory onset, differential offset, with an earlier offset of motor than sensory blockade, enabling early ambulation/movements with prolonged analgesia.

Currently, levobupivacaine (S-enantiomer of bupivacaine) with favorable clinical profile and lesser cardiotoxicity when compared with racemic bupivacaine[3] is being used for regional block. Ropivacaine has a long duration of action, with similar pharmacology to bupivacaine but a wider safety margin.[4]

Many drugs have been used as adjuvants to local anesthetic agents to prolong the duration of peripheral nerve blocks. Clonidine, a partial α -2 adrenoceptor agonist has been reported to prolong the duration of anesthesia and analgesia during such blocks.[5] The α 2: α 1 selectivity of dexmedetomidine is eight times that of clonidine and its high specificity for α 2 subtype makes it a much more effective sedative and analgesic agent.[6] In human beings, dexmedetomidine has shown to prolong the duration of block and postoperative analgesia when added to local anesthetic in various regional blocks.[7,8] Most human studies of dexmedetomidine as an adjuvant to local anesthetics involved combinations with bupivacaine or levobupivacaine.[9,10] Due to unique pharmacologic properties and fewer side effects, ropivacaine is being preferred by an increasing number of anesthesiologists for peripheral nerve blocks, in combination with dexmedetomidine.[11]

The current study was designed with aim to comparatively evaluate the effect of adding dexmedetomidine to levobupivacaine 0.5% and to ropivacaine 0.5% in supraclavicular brachial plexus block in terms of onset and duration of sensory and motor block and duration of postoperative analgesia.

However, the comparative evaluation of these combinations in supraclavicular brachial plexus block has not been studied till now; hence, the need for this study.

II. Materials and Methods

This was a double blind, prospective randomized clinical trial conducted in the Deptt of Anaesthesia of Tertiary Care Hospital. After approval of Hospital Ethical Committee a study was planned among 90 American Society of Anesthesiologist (ASA) Grade I and II patients in the age group of 18-65 years, posted for elective upper limb orthopedic surgeries under brachial plexus block using supraclavicular approach. Patients with diabetes, peripheral neuropathy, with known allergy to LAs, coagulopathy, infection at the site of block, pregnancy, and patients on beta blockers were excluded from the study.

Preoperatively patients were counseled and familiarized with the use of Visual Analogue scale (VAS) pain score for the assessment of perioperative pain. After obtaining written informed consent, patients were randomly divided into two groups using sealed envelopes technique. A sealed envelope was randomly selected and opened by an assistant, with instructions to draw up the relevant drug. The syringe was labeled with the patient's name and handed to the investigator who performed the block. An independent observer (senior

anesthesiologist posted on duty, not included in the study) then observed the onset and offset of sensory and motor blockade and analgesia. Blinding was opened at the end of the study. Group A received solution containing 30 ml 0.5% levobupivacaine and 1mcg/kg dexmedetomidine and group B received 30 ml Ropivacaine with dexmedetomidine 1 µg/kg body weight. Standard anesthetic monitoring was established using electrocardiogram monitor, pulse oximeter, SpO₂ and a noninvasive blood pressure monitor.

All the patients were kept fasting 6-8 hours prior to scheduled procedure. An IV access was achieved on the nonoperative arm prior to performing supraclavicular brachial plexus block. Patients were kept in the supine position with the arm by side of the trunk and extended along the side towards the ipsilateral knee as far as possible, and the head slightly turned to the opposite side. The supraclavicular brachial plexus block was performed using subclavian perivascular technique described by Kulenkampff, modified by Winnie and Collins.[12] The brachial plexus was located using standard peripheral neurostimulator (Stimuplex[®], B Braun) with 2-Hz and 1.0-mA. The site that triggered muscular response to a stimulus equal to or lower than 0.4 mA was located, and Local anaesthetic mixture was given, after fixing the stimulating needle, aspirating in between to avoid inadvertent intravascular injection.

Sensory block was assessed by loss of sensation to pin prick over the C5-T1 dermatomes using a three-points scale[13] (0-Sharp pain, 1-Dull pain [analgesia], 2-No pain [anesthesia]). Similarly, motor block was assessed using Bromage Scale[14] (0-Normal motor functions with full flexion and extension of the elbow, wrist and fingers, 1-Decreased motor strength with the ability to move fingers only, 2-Complete motor blockade with inability to move fingers). Sensory and motor blocks were assessed every 2 min for first 10 min and then every 3 min until 30 min after injection, and then every 30 min after surgery, until recovery. Sensory onset time was defined as the time interval between the end of LA administration and establishment of score 2 on three-point scale on all nerve territories. Duration of sensory block was defined as the time interval between the end of LA administration and the complete resolution of anesthesia (score 0 on three-point scale) on all nerves. Complete motor block was defined as the absence of voluntary movement on hand and forearm (score 2 on Bromage Scale). Duration of motor block was defined as the time interval between the end of LA administration and the recovery of complete motor function of the hand and forearm (score 0 on Bromage Scale). Block was considered inadequate when sensory anesthesia was not achieved within 30 min. General anesthesia was given subsequently to these patients who were then excluded from the analysis. Supplemental oxygen was provided to all the patients through nasal canula throughout the surgery.

After taking a preoperative baseline value, vital parameters, that is, systolic blood pressure (SBP), diastolic blood pressure (DBP), arterial saturation (SpO₂), respiratory rate (RR), and heart rate (HR) were monitored at every 5 min throughout the surgery and postoperatively one hourly till first 24 h. Adverse events such as hypotension (20% decrease in relation to the baseline value), bradycardia (HR <60 bpm), hypoxemia (SpO₂ 90%) and perioperative nausea and vomiting were recorded.

Patient's perception of pain was assessed using VAS (0-10). Rescue analgesics in the form of injection fentanyl 1 µg/kg body weight was given in case patient complained of intraoperative discomfort at any time of surgery (VAS >3). Patients were monitored for 24 h postoperatively to assess total duration of sensory and motor blockade and VAS pain score.

Postoperatively rescue analgesia in the form of nonsteroidal anti-inflammatory drugs (injection diclofenac sodium 75 mg) was given when patient complained of VAS >3. Injection fentanyl 1 µg/kg body weight was administered if patient still complained of pain. The patients were continuously monitored for any perioperative complications and adverse reactions.

III. Results

45 patients in Group L and 45 patients in Group R had satisfactory block and those with unsatisfactory block i.e 2 patients in Group L and none in Group R were excluded from the study.

The two groups did not vary in terms of demographic data.

The mean time for complete sensory onset in Group L was 13.2 minutes and in Group R 9.5 minutes, which was clinically and statistically significant. The two groups did not differ significantly with respect to mean time for complete motor block being 16.3 minutes and 15.6 minutes in Group L and Group R respectively.

Mean duration of Sensory block in Group L was 893 minutes and 630 minutes in Group R which was highly significant clinically and statistically. Mean duration of Motor block in Group L was 840 minutes and 545 minutes in Group R which was highly significant clinically and statistically. Mean duration of Analgesia in Group L was 997 minutes and 805 minutes in Group R which was highly significant clinically and statistically. All the patients remained haemodynamically stable throughout the procedure. Results were analysed using SPSS software.

Variables	Group L	Group R	P-value
Age (in years)	37.67+-8.8	38.18+-9.04	0.787
Sex (M/F)	24/21	26/19	0.671
Weight (Kgs)	68.16+-8.46	65.39+-8.32	0.120

Variables	Group L	Group R	P-value
Onset time Sensory block (min)	13.2+-1.848	9.5+-5.8	P=0.0001
Onset time Motor block (min)	16.3+-1.7	15.6+-6.3	P=0.47
Duration Sensory block (min)	893.0+-32.33	630.6+-208.2	P<0.0001
Duration Motor Block (min)	840.3+-50.23	545.9+-224.0	P<0.0001
Duration of Analgesia (min)	997.4+-154.23	805.7+-205.9	P<0.0001

IV. Discussion

Upper limb blocks are widely used because of widespread acceptance, safety and reliability. Its acceptance is widely increasing because of what it renders: prolonged pain relief and shorter hospital stay which are two important goals of modern anaesthesia practice.

Bupivacaine is most commonly used long acting amide anaesthetic agent in supraclavicular plexus block. Due to relatively large volume of local anaesthetic agent required for Supraclavicular brachial plexus block, systemic toxicity remains a concern (15). Levobupivacaine, S-enantiomer of bupivacaine, with favorable clinical profile and lesser cardiotoxicity (3) was used in our study. Ropivacaine, too pure S-enantiomer is less cardiotoxic than bupivacaine. Resuscitation after ropivacaine toxicity is more successful than bupivacaine.(16,17,18). Hence, we selected to compare levobupivacaine and ropivacaine in our study.

Various adjuvants have been used alongwith bupivacaine and ropivacaine in performing supraclavicular blocks. Dexmedetomidine, α -2 adrenoceptor agonist has been used alongwith levobupivacaine (19,20,21,22) and ropivacaine (1,23) in various studies for performing supraclavicular brachial plexus block.

No such study which comparatively evaluate the effect of adding dexmedetomidine to levobupivacaine 0.5% and ropivacaine 0.5% in supraclavicular brachial plexus block in terms of onset and duration of sensory and motor block and duration of postoperative analgesia has been performed till date.

In our study, we found that levobupivacaine dexmedetomidine combination results in faster onset of sensory block, prolongs the duration of sensory and motor block, prolongs duration of post-operative analgesia in comparison to ropivacaine dexmedetomidine combination. However, there was no statistically significant difference in terms of time taken for onset of motor block.

V. Conclusion

Our study comparatively evaluated the effect of adding dexmedetomidine to levobupivacaine 0.5% and ropivacaine 0.5% in supraclavicular brachial plexus block in terms of onset and duration of sensory and motor block and duration of postoperative analgesia. We concluded that levobupivacaine dexmedetomidine combination results in faster onset of sensory block, prolongs the duration of sensory and motor block, prolongs duration of post-operative analgesia in comparison to ropivacaine dexmedetomidine combination.

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