

A Comparative Study of Anaesthetic Properties of Bupivacaine Alone and in Combination with Dexmedetomidine for Supraclavicular Brachial Plexus Block in Patients Undergoing Upper Limb Surgeries

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Abstract: *Background and Aims:* Regional Anaesthesia Is A Recommended Technique For Upper And Lower Limb Surgeries With Better Postoperative Profile. In This Hospital Based Randomized Double Blind Interventional Study, We Compared The Effects Of Adding Dexmedetomidine To Bupivacaine In Supraclavicular Brachial Plexus Block. Onset of Sensory And Motor Block Along With Duration Of Analgesia Were The Primary End Points. *Material and Methods:* After Obtaining Ethical Committee Approval, A Hospital Based Randomized Double Blind Interventional Study Was Conducted On 60 Patients With ASA Grade 1 And 2 In The Age Group 20 To 50 Years, Posted For Upper Limb Surgeries. Divided Randomly Into Two Groups, Group A Will Receive 0.5% Bupivacaine 20 MI(100 Mg) + 10.0 MI Normal Saline (Total Volume 30 MI) And Group B Will Receive 0.5% Bupivacaine 20 MI(100 Mg) + 1 MI(100µg) Dexmedetomidine Diluted To 10 MI With Normal Saline (Total Volume 30 MI) For Supraclavicular Brachial Plexus Block. Onset of Sensory And Motor Block Along With Duration Of Analgesia And Adverse Effects Monitored, Hemodynamic Parameters Like Heart Rate (HR), Systolic Arterial Blood Pressure (SBP) And Diastolic Arterial Blood Pressure (DBP) Were Also Monitored. *Results:* Demographic Data And Surgical Characteristics Were Comparable In Both Groups. The Onset Time Of Sensory And Motor Blocks Were Significantly Shorter In Group B Than Group A ($P < 0.001$), Duration Of Analgesia Was Significantly Longer In B Groups Than Group A ($P < 0.001$). *Conclusion:* Dexmedetomidine Added As An Adjuvant To Bupivacaine For Supraclavicular Brachial Plexus Block Significantly Shortens The Onset Time And Prolongs The Duration Of Analgesia.

1. Introduction

- The taxonomy committee of international association for the study of Pain (IASP) defines pain as “An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage¹.” Inadequate pain control, apart from being inhuman, may result in increased morbidity or mortality. Effective Management of postoperative pain relieves suffering and leads to earlier mobilization, shortened hospital stay, fewer pulmonary and cardiac complications, a reduced risk of deep vein thrombosis, faster recovery with less likelihood of the development of neuropathic pain, reduced cost of care and increased patient satisfaction².
- Regional anesthesia is the administration of local anesthetic agents and adjuvants to specific anatomic areas, resulting in a combination of motor and sensory blockade. Regional anesthesia can be divided into central blocks and peripheral blocks based on the proximity of the infiltration site to the spinal cord. Brachial plexus block is a peripheral block commonly used in both inpatient and outpatient settings for upper extremity surgery and in postoperative rehabilitation³. Brachial plexus nerve blocks used are supraclavicular, infraclavicular, interscalene and axillary. The type of brachial plexus block used depends on the type and magnitude of the surgery as well as patient characteristics and preferences. Peripheral nerve blocks not only provide intraoperative anesthesia but also extend analgesia in the postoperative period without major systemic side effects by minimizing stress response and using minimal anesthetic drugs.
- Regional anesthesia of the upper extremity has several clinical applications and is reported to have several advantages over general anesthesia. These advantages, such as improved postoperative pain, decreased postoperative opioid administration, and reduced recovery time, have led to widespread acceptance of a variety of regional nerve blocks.
- Local anesthetics alone for supraclavicular brachial plexus block provide good operative conditions but have shorter duration of postoperative analgesia. Hence in recent years it has gained popularity with addition of various adjuncts to local anaesthetic solution in an attempt to increase its efficacy and duration while minimizing systemic adverse effects along with a reduction in total dose of local anaesthetic used. Adjuncts like opioids⁴, clonidine⁵, dexamethasone⁵, midazolam⁶ etc. have been injected concomitantly with local anaesthetic solution in brachial plexus block to achieve quick, dense, and prolonged block, but the results are either inconclusive or associated with side effects.
- The local anaesthetic bupivacaine has been proposed to inhibit Na⁺ channels indirectly by making the resting potential less negative. bupivacaine exerts its main anaesthetic action on myelinated nerve axons by a direct modification of Na⁺ channels⁸.
- Alpha-2 agonists are mixed with local anaesthetic agents to extend the duration of spinal, extradural and peripheral nerve blocks. Dexmedetomidine (alpha-2 agonist) when

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added to local anaesthetic in supraclavicular brachial plexus block enhanced the duration of sensory and motor block and also the duration of analgesia. The time for rescue analgesia was prolonged in patients receiving dexmedetomidine. It also enhanced the quality of block⁹.

- The present study was conceived to examine the effect of adding Dexmedetomidine as an adjuvant to local anaesthetic Bupivacaine 0.5% for institution of Supraclavicular Brachial Plexus block
- **Swami SS et al (2012 May)** have studied Dexmedetomidine when added to local anaesthetic in supraclavicular brachial plexus block enhanced the duration of sensory and motor block and also the duration of analgesia. The time for rescue analgesia was prolonged in patients receiving dexmedetomidine. It also enhanced the quality of block as compared with clonidine¹⁰.

Bharti N et al (2015 Dec) have studied that the addition of dexmedetomidine to ropivacaine-lidocaine prolonged the duration of supraclavicular brachial plexus block and improved postoperative analgesia without significant adverse effects in patients undergoing upper limb surgeries¹¹.

Nazir N et al (2016 Nov) have studied that dexmedetomidine as adjuvant to bupivacaine in supraclavicular block resulted in faster action, prolonged motor and sensory block, prolonged analgesia with hemodynamic stability and adequate sedation¹².

Aim: To evaluate the effects of DEXMEDETOMIDINE as an adjuvant to BUPIVACAINE in comparison to plain BUPIVACAINE for supraclavicular brachial plexus block in patients undergoing upper limb surgery.

- 1) To determine difference in Onset time of Sensory and Motor Block in both group.
- 2) To determine difference in Duration of Analgesia in both group.

2. Materials and Methods

The study was conducted in the Department of Anesthesiology, S.M.S Medical College and attached hospitals, Jaipur. Hospital based randomized double blind interventional study.

The study population was divided into two groups. Each group was consist of 30 patients (n=30/group).

- Group A received 0.5% Bupivacaine 20 ml(100 mg) + 10.0 ml Normal Saline (Total volume 30 ml)
- Group B received 0.5% Bupivacaine 20 ml(100 mg) + 1 ml(100µg) Dexmedetomidine diluted to 10 ml with normal Saline (Total volume 30 ml)

Inclusion Criteria:-

- Patients of either sex
- Age group between 20 and 50 years
- Body weight 50 to 70 kg.
- Patients belonging to ASA class I and II
- Patients undergoing upper limb surgeries of duration 1-4 hours in elective theatre

Exclusion Criteria:-

- Patients not willing to participate in the study
- Uncooperative patients
- Local pathology at the site of injection or disability limiting the performance of block
- History of convulsion, allergy to the drug used, bleeding disorder, severe neurological deficit
- Patient with history of respiratory, cardiac, hepatic or renal disease (necessitating classification in ASA Class III or above)
- Inadequate block necessitating institution of general anaesthesia for continuation of surgical procedure

3. Assessment

Patient satisfying inclusion criteria were selected. Fasting status, PAC, Informed written consent checked. Pre-operative vitals (BP, PR, RR, SpO₂, ECG) were recorded. I.V. line will be secured, I.V. Fluid started. Patient did not receive any premedication. However perioperative sedation was achieved by using inj. Midazolam 1 mg iv. The patient was placed in the supine position, with the head turned away and the ipsilateral arms adducted. The interscalene groove and mid-point of the clavicle and subclavian artery was identified. After aseptic preparation of the area, at a point 1.5 to 2.0 cm posterior to midpoint of the clavicle a skin wheal was raised with a local anesthetic (lignocaine 2% plain).

A 22G, 50 mm "short beveled" needle was passed through the same point in a caudal, slightly medial and posterior direction, until either a paresthesia is elicited or the first rib is encountered. If the first rib is encountered, the needle will be moved over the first rib until a paresthesia is elicited either in the hand or arm. After eliciting paresthesia and negative aspiration of blood, the study medication was injected. After performance of nerve block patients was evaluated for onset of sensory block every 2 minute. The sensory block was assessed by pin prick with 25 gauge needle.

Heart rate, non-invasive blood pressure and SPO₂ and sedation score were measured every 5 minutes for 10 minutes and thereafter every 10 minutes. Postoperatively heart rate, noninvasive blood pressure and pain and motor power & sedation score were recorded at 0 min, 30 min, 1hr, 3hrs, 6hrs, 12hrs 18hrs and 24hrs. Postoperatively time of return of complete sensory and motor power will be recorded and rescue analgesic (Inj Diclofenac 75 mg IV) will be administered at VAS score >3 and the time will be noted. Side effects and complications if any.

4. Observation and Results

The age, body weight, height and ASA status difference was not significant in the 2 groups.

Duration of surgery was also comparable in the two groups with no significant difference.

The Observations are presented as Mean ± Standard Deviation or as Percentages as is applicable.

Table 1: Mean Onset of Sensory Block (Mean ± SD) (95% confidence interval)

	Group A (n=30)		Group B (n=30)		P value
	Mean	SD	Mean	SD	
Sensory Block (Minutes) (Confidence interval)	15.87 (15.20-16.53)	1.85	11.44 (10.83-12.03)	1.67	<0.0001

Table 1, show the mean onset of sensory block along with standard deviation and 95% confidence interval. The mean onset of sensory block for Group A was 15.87 ± 1.85 (min) and for Group B was 11.44 ± 1.67 (min) and the difference was found to be statistically significant (p < 0.0001).

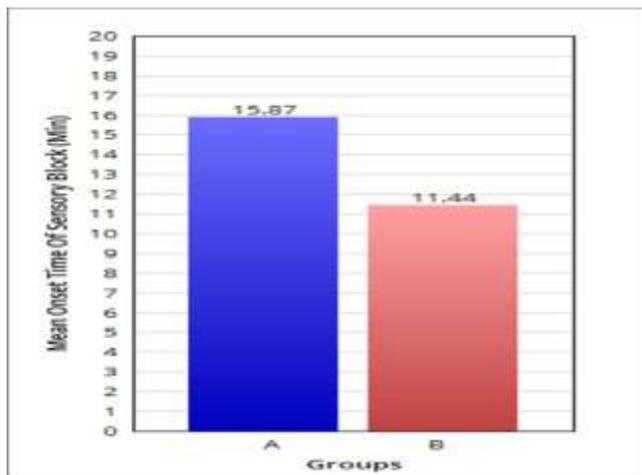


Figure 1: Onset of Sensory Block

Table 2: Mean Onset of Motor Block (Mean ± SD) (95% confidence interval) in each Group

	Group A (n=30)		Group B (n=30)		P value
	Mean	SD	Mean	SD	
Motor Block (minutes) (Confidence interval)	19.03 (18.25-19.82)	2.19	14.17 (13.52-14.81)	1.80	<0.0001

Table 2, shows the mean onset of motor block with standard deviation and 95% confidence interval. The mean onset of motor block for Group A was 19.03 ± 2.19 (min) and for Group B was 14.17 ± 1.80 (min) and the difference was found to be statistically significant between the groups (p < 0.0001).

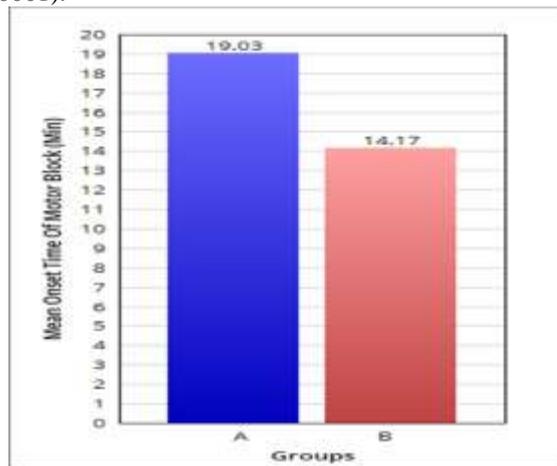


Figure 2: Onset of Motor block in each Group

Table 3: Duration of analgesia [Mean ± SD] (95% confidence interval)

	Group A (n=30)		Group B (n=30)		P value
	Mean	SD	Mean	SD	
Duration of analgesia (minutes) (Confidence interval)	332.50 (320.07-344.93)	34.73	807.17 (792.00-822.32)	42.36	<0.0001

Table 3, shows The mean duration of analgesia in Group A was 332.50 ± 34.73 (min) and in Group B was 807.17 ± 42.36 (min) that was found to be statistically significant between the groups (p<0.05).

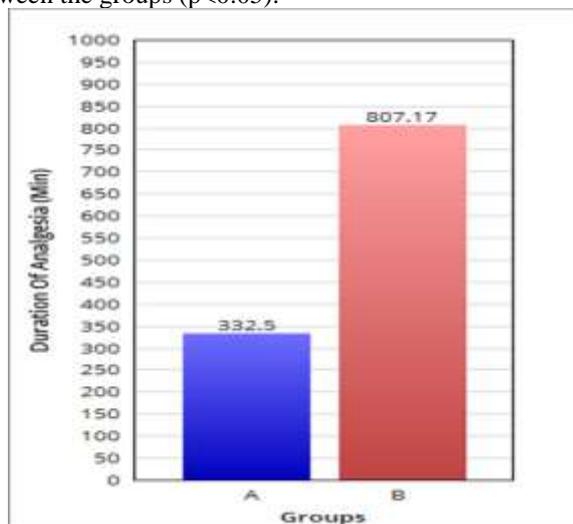


Figure 3: Duration of Analgesia in each group

5. Discussion

It is well recognized that the postoperative pain is most often being under treated. The mixing of analgesics with local anesthetics for regional anesthesia provides a better alternative. Although many drugs (morphine, nalbuphine, clonidine, vasoconstrictors like epinephrine and phenylephrine) have been used as an adjuvant to local anesthetics but high incidence of side-effects (respiratory depression, sedation, cardiovascular instability, nausea-vomiting, pruritus, and urinary retention) and relatively ineffectiveness resulted in reluctance to administer these drugs.

Dexmedetomidine, a new highly selective α₂-agonist, is under evaluation as an adjuvant as it provides stable hemodynamic conditions, good quality of intraoperative and prolonged postoperative analgesia with minimal side effects. Kalso et al reported that dexmedetomidine affinity to α₂-adrenoceptor agonists is 10 times as compared to clonidine¹³.

This randomized comparative interventional study included 60 Patients (age 20-50 years) who underwent elective surgery of upper limb in the orthopaedic department. The patient selected in the present study belonged to ASA grade – I and II.

In our study mean onset of sensory block was 11.44 ± 1.67 min in dexmedetomidine group and 15.87 ± 1.85 min in control group, and mean onset of motor block was 14.17 ± 1.80 min in dexmedetomidine group and 19.03 ± 2.19 min in control group. It was significantly earlier in dexmedetomidine group as compare to control group. ($p < 0.05$)

Our observations were similar with the study of Agarwal S et al⁹ they found that the onset of sensory and motor block was earlier in Dexmedetomidine group as compared to control group. The faster onset could be due to local action of dexmedetomidine on nerve compound action potential as well as enhancement of anesthetic action of LA. Similar results were obtained by Nazir N et al¹² who observed that Dexmedetomidine significantly shortens the time of onset of sensory and motor block.

In our study, we observed that duration of analgesia was 807.17 ± 42.36 min in dexmedetomidine group and 332.50 ± 34.73 min in control group which was statistically significant between the groups ($p < 0.05$).

Our observations were similar with the study of Agarwal S et al⁹ they found that the duration of analgesia was prolonged in Dexmedetomidine group as compared to control group. The result can be explained by peripheral and central actions of dexmedetomidine. Peripherally, it produces analgesia by decreasing the release of norepinephrine which causes inhibition of on nerve action potentials. Centrally, it causes inhibition of the release of substance P in the nociceptive pathway at the level of the dorsal root neuron which produces analgesia. Similar results were obtained by Swami SS et al¹⁰, Tripathi A et al¹⁴ and Nallam SR et al¹⁵ they observed that Dexmedetomidine significantly prolonged the duration of analgesia.

6. Conclusions

From our study, we conclude that the addition of 100mcg dexmedetomidine as adjuvant to 0.5% Bupivacaine for supraclavicular brachial plexus block shortens the onset time of sensory and motor blocks. The significantly prolonged duration of analgesia, the time to request of first postoperative rescue analgesia is significantly longer on addition of dexmedetomidine.

The added advantage of conscious sedation, hemodynamic stability and minimal side effects makes it a potential adjuvant for nerve blocks.

Limitations:-Further studies with large sample sizes are warranted to validate these findings.

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