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RESEARCH ARTICLE

SUPRACLAVICULAR BLOCK IN PATIENTS UNDERGOING UPPER LIMB SURGERIES

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ABSTRACT

Background: Brachial plexus block has now evolved into a valuable and safe alternative to general anaesthesia for upper limb surgeries. Various approaches like interscalene, supraclavicular, infraclavicular and axillary have been used for blocking the brachial plexus. Supraclavicular approach gives the most effective block for upper extremity and is carried out at level of trunks of brachial plexus. **Objectives**: To determine and compare the efficacy of supraclavicular block of brachial plexus with bupivacaine (0.5%) with dexmedetomidine (30 µg) and levobupivacaine (0.5%) with dexmedetomidine (30 µg) for brachial plexus blockade. **Material & Method:** This prospective, randomized, double blinded, controlled trial was conducted on patients of either sex, aged between 18 to 60 years with ASA class I and II posted for upper limb surgeries. Two groups comprising of 30 patient in each group, who received bupivacaine + dexmedetomidine, or levobupivacaine + dexmedetomidine, were selected to compare their effects on onset, duration and quality of BPB. **Results:** Onset of sensory block was early in Group B (6.45+0.91 minutes) as compared to that in Group A (8.02+0.82 minutes). Onset of motor block too was early in Group B (9.02+0.90 min) as compared to Group A (10.01+0.88 min.) Duration of sensory block was statistically significantly longer in Group B (891.50+68.38 min) as compared to Group A (756.67+64.68 min). Duration of motor block was statistically significantly longer in Group B (788.83+62.97 min) as compared to Group A (700.67+64.67 min). Duration of total block was statistically significantly longer in Group B (1002.67+43.54 min) as compared to Group A (787.07+61.62 min). **Conclusion**: Our study revealed that 30µg dexmedetomidine as adjuvant to levobupivacaine in supraclavicular brachial plexus block improves sensory, motor block characteristics, hemodynamics, and VAS pain scores without clinically relevant adverse effects.

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INTRODUCTION

Brachial plexus block (BPB), alone or in combination with general anaesthesia (GA) has become one of the most important anaesthesia techniques for various upper limb surgeries, due to its effectiveness in terms of cost and performance, margin of safety and good post-operative analgesia. It provides excellent analgesia and muscle relaxation and considerably decrease the peri-operative and post-operative opioid requirements (Borgeat, 1998 and Fredrickson, 2010). If we limit the block to a single injection, the effect begins to wane after few hours (hrs) (Lund, 1970). Methods to prolong analgesia beyond the actual duration of the local anesthetic (LA) agent used include either placement of perineural catheters to allow continuous infusion or co-administration of adjuvants like epinephrine, clonidine, dexamethasone, dexmedetomidine or midazolam (Cummings, 2011 and Popping, 2009).

Supraclavicular approach gives the most effective block for upper extremity and is carried out at level of trunks of brachial plexus. It is well established that bupivacaine & levobupivacaine, provides prolonged analgesia when mixed with various adjuvants for peripheral nerve blocks. There has been many studies comparing the efficacy of bupivacaine & levobupivacaine, but not many studies have been done comparing the efficacies of these two drugs with dexmedetomidine as an adjuvant in a single study. Hence, the present study was undertaken to compare the efficacy of dexmedetomidine as an adjuvant to 0.5% bupivacaine and 0.5% levobupivacaine in supraclavicular brachial plexus block. Bupivacaine is a racemic mixture of both the R and S enantiomers, provides prolonged and intense sensory analgesia, often outlasting the motor block. Levobupivacaine is the levogyrus isomer [S(-) enantiomer] of racemic bupivacaine, and compared to this, in animal studies and studies on human volunteers, seems to be less cardiotoxic and neurotoxic.

Dexmedetomidine is dextro (s) isomer of medetomidine, a central alpha 2 agonist.Approved for short term sedation by FDA–USA, an intravenous anesthetic agent and selective α2 receptor agonist. (α_2:α_1 1620:1).

MATERIALS AND METHODS

After getting approval from the scientific & ethical committee, KGMU, Lucknow, UP, an informed consent was taken from the included patients after proper explanation of the study procedure and expected outcome in their own language. This prospective, randomized, double blinded, controlled trial was conducted on patients of either sex, aged between 18 to 60 years with ASA class I and II posted for upper limb surgeries. Patients with age group less than 18 years and more than 60 years belonging to ASA grade III, IV, with known hypersensitivity to LA's and dexmedetomidine, infection at the site of block, with known coagulopathy or patient on anticoagulants therapy, with severe systemic disorder (respiratory, cardiac, hepatic, renal diseases, neurological, psychiatric, neurovascular disorders and contralateral diaphragmatic paralysis), pregnant and lactating patients were excluded from the study.

The following parameters were studied

Onset of sensory block: The time from injection to onset of analgesia in each of the major peripheral nerve distributions (ulnar, radial, medial and musculocutaneous nerves). Sensory block was assessed by pinprick using the blunt end of a 22-gauge needle at 0, 5, 10, 15, 20, 30, 40, 50 and 60 min. Sensory block was graded according to the following scale: 0=no block (normal sensation), 1=partial block (decreased sensation), and 2=complete block (no sensation).

Table 1 Sensory test sites and motor test

	Motor Test	Sensory Test Site
Median	Flexion of 3 fingers	Thenar eminence
Ulnar	Abduction of fingers	Hypothenar eminece
Radial	Extension of wrist	Dorsum of hand
Musculocutaneous	Elbow flexion	Over base first metacarpal
Medial Cutaneous Antebrachial	*	Median side of arm

Onset of motor block: The time from injection to the inability of the patients to move their fingers or raise their hand. Motor block was measured at 0, 5, 10, 15, 20, 30, 40, 50 and 60 min by assessing the following motor functions: flexion at the elbow (musculocutaneous nerve), extension of the elbow and the wrist (radial nerve), opposition of the thumb and index finger (median nerve), and opposition of the thumb and small finger (ulnar nerve). Motor block was graded according to the Lovett rating scale (Paternostro-Sluga, 2008).

Duration of analgesia: During the procedure, anaesthesia was considered satisfactory if the patient did not complain of any pain or discomfort and if no sedation was necessary. Post-operative follow up was carried out in the recovery and post-operative ward. The duration of analgesia was noted according to 0-10 visual analogue score (VAS) for pain. When the patients began to experience the pain (VAS >4), it was considered that analgesic action of the drugs was terminated.

Duration of motor block: The duration of motor block post-operatively was assessed every hourly by asking the patients to move their fingers and to see whether they were able to raise the hand or not (time interval between end of LA administration and return of motor power to Lovett rating score 6). This time was recorded and taken as cessation of motor block effect.

Duration of sensory block: Duration of sensory block was defined as the time interval between the end of LA administration and normal sensation (sensory score = 0).

Ramsay sedation score: In our study base line sedation score was 2 according to Ramsay sedation scale when patients were taken in operation theatre before any anaesthetic intervention, as all the patients were calm and cooperative. Sedation score was studied throughout the study according to Ramsay Sedation Scale.

All of the above assessments were carried out by the principal investigator who was blinded to the drugs administered in the brachial plexus block. Preanaesthetic evaluation was done in the evening before surgery.

Procedure: On the day of surgery, upon arrival in the operating room, the patient was connected to multichannel monitor which records HR, non-invasive measurement of BP, continuous ECG monitoring and SpO_2. The baseline BP and the HR were recorded. An 18G IV cannula was inserted on the non-operating hand, and iv fluid was started. After appropriate preparation and development of a skin wheal, the neural localization was achieved by a nerve stimulator connected to a 22 G, 50-mm-long stimulating needle (Stimuplex, Braun, Germany). The location end point was a distal motor response with an output lower than 0.5 mA (miliamperes). On localization of the brachial plexus, negative aspiration for blood and air was performed before incremental injections of LA solution. Assessment of block was carried out every 5 mins till the achievement of motor and sensory block and then every 30 mins till the completion of surgery and thereafter every hourly till first 12 hrs, and then 6 hourly until the block had completely worn off. Patients were monitored for any signs of CVS/CNS toxicity throughout the study. Any hypersensitivity reaction for the drugs, evidence of pneumothorax, and other adverse events were also monitored.

Statistical Tools Employed: The sample size has been calculated using the formula proposed by Snedecor and Cochran, (1989)[1]:

$$n = [16\sigma^2/d^2] + 1$$

whereσ is the standard deviation and *d* is the mean difference between two groups. The proposed mean difference between two groups is 0.7 hrs, with a pooled standard deviation of0.91 hr. Thus in present study σ =0.91 and d=0.7 hr. Putting these values in formula we get the equation

$$n = [\{16\ (0.91^2)\}/\ (0.7^2)] + 1$$

$$=13.25/\ 0.49+\ 1$$

$$=\ 27.0408 + 1 = 28.0408 \simeq 28$$ patients in each group

Thus the calculated sample size at 95% confidence and 80% power, is 28 in each group. After adding for a contingency of 8%, the proposed sample size is 30 in each group.

Group BD: 30 ml bupivacaine 0.5% + dexmedetomidine 30 µg.

Group LD: 30 ml levo-bupivacaine 0.5% + dexmedetomidine 30 µg.

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 15.0 statistical Analysis Software. The values were represented in Number (%) and Mean±SD. Following tests were applied – chi square test, student 't' test, paired 't' test, Mann Whitney U test.

RESULTS

The present study was conducted in the Department of Anaesthesiology, King George's Medical University, Lucknow, U.P. to determine and compare the efficacy of supraclavicular BPB with bupivacaine (0.5%) with dexmedetomidine (30 µg) and levobupivacaine (0.5%) with dexmedetomidine (30 µg) for upper limb surgeries. Though mean weight of patients of Group A (64.77±7.72 kg) was found to be higher than that of Group B (64.03±6.94 kg) but this difference was not found to be statistically significant (p=0.700).The same can be said about other anthropometric variables i.e. the difference in mean height and mean BMI of patients in both the groups was not found to be statistically significant.

Onset of sensory block was early in Group B (6.45±0.91 minutes) as compared to that in Group A (8.02±0.82 minutes). Difference in time of sensory block between above two groups was found to be statistically significant (p<0.001). Onset of motor block too was early in Group B (9.02±0.90 min) as compared to Group A (10.01±0.88 min.) and between group difference in time onset of motor block was found to be statistically significant.

Duration of sensory block was statistically significantly longer in Group B (891.50±68.38 min) as compared to Group A (756.67±64.68 min).

Duration of motor block was statistically significantly longer in Group B (788.83±62.97 min) as compared to Group A (700.67±64.67 min).

Duration of total block was statistically significantly longer in Group B (1002.67±43.54 min) as compared to Group A (787.07±61.62 min).

At baseline (0 min), median and mean pain score (VAS) of Group A was 2 and 2.40±0.86 while that of Group B was 3 and 2.53±0.90. Difference in pain score of Group A and Group B was not found to be statistically significant (p=0.521).

At 5 min, median and mean pain score (VAS) of Group A was 1 and 1.33±0.55 while that of Group B was 0 and 0.40±0.50. Difference in pain score of Group A and Group B was found to be statistically significant (p<0.001).

At rest of the periods of observation (10 min – 24 h) no pain was observed by any of the patient in both the groups. Pain score at all these periods of observation in both the groups was similar (0.00±0.00).

At baseline, Ramsey sedation score of all the patients of both the groups was 2, median and mean Ramsey Sedation score of both the groups were 2.00 and 2.00±0.00 and were found to be similar.

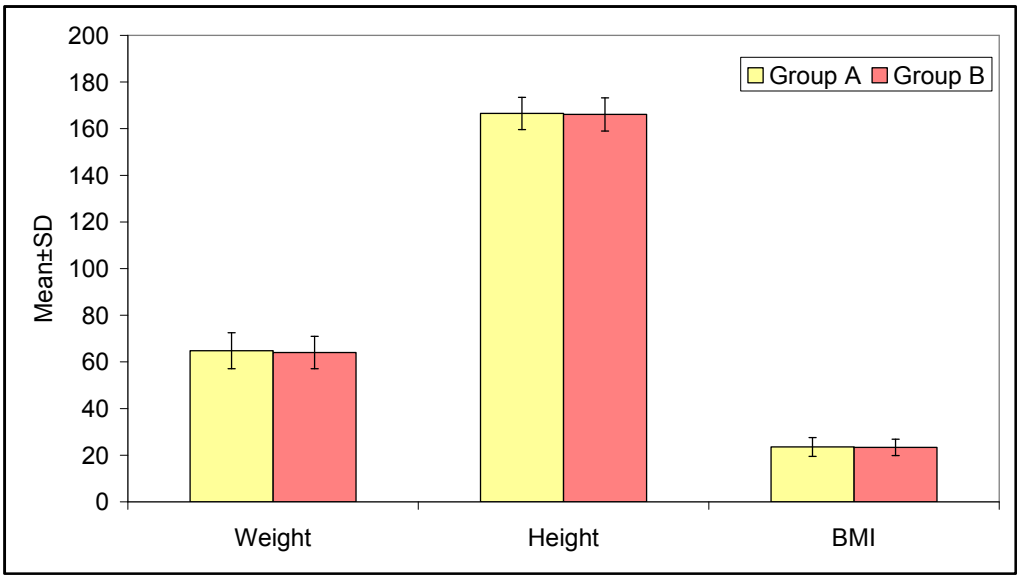
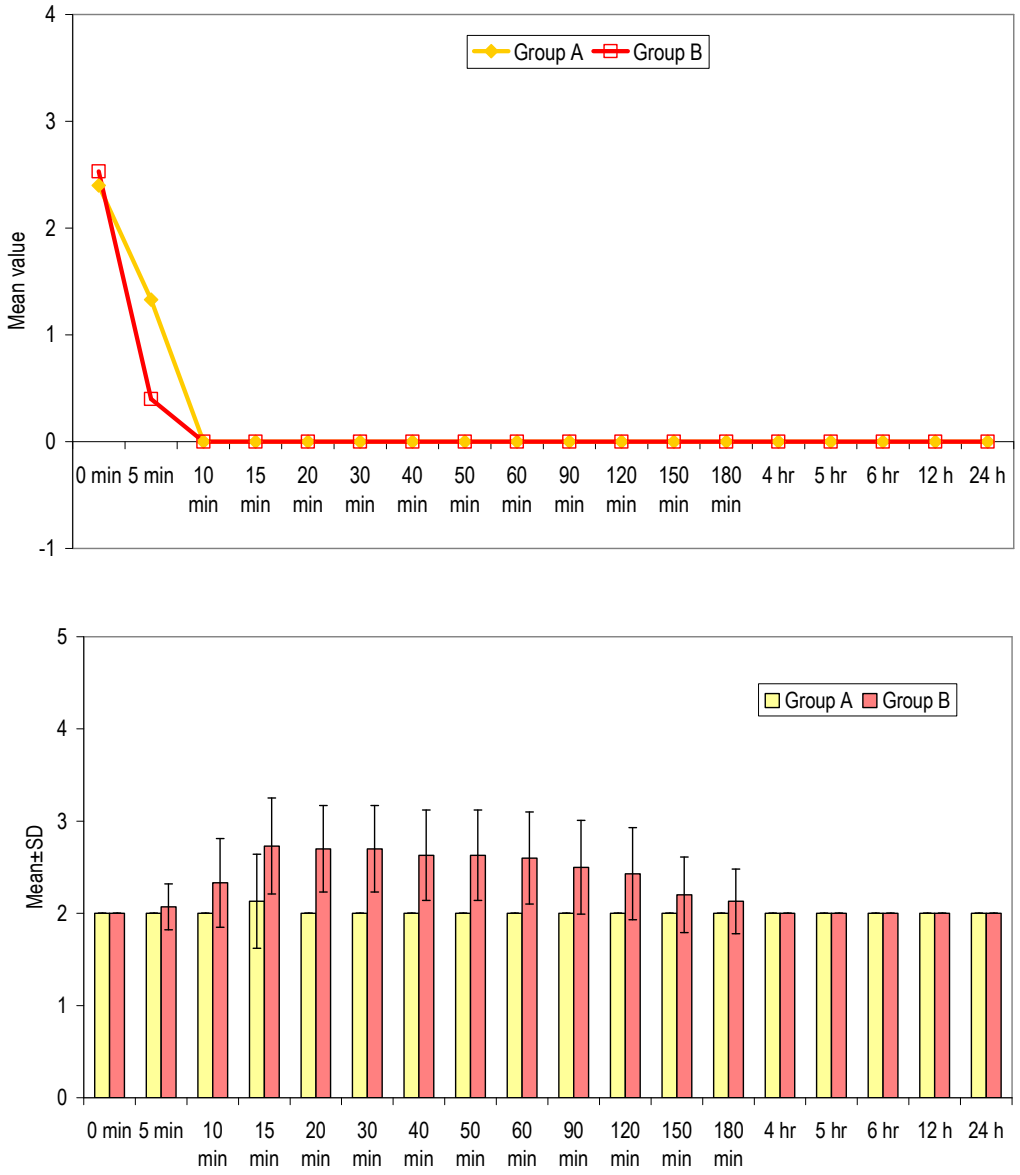


Table 1. Between Group Comparison of Analgesic characteristics

Time interval	Group A (n=30)		Group B (n=30)		Statistical significance	
	Mean	SD	Mean	SD	't'	'p'
Sensory blockade Onset (in min.)	8.02	0.82	6.45	0.91	7.029	<0.001
Motor blockade onset (in minutes)	10.01	0.88	9.02	0.90	4.314	<0.001
Duration of sensory blockade	756.67	64.68	891.50	68.38	-7.846	<0.001
Duration of motor blockade	700.67	64.67	788.83	62.97	-5.350	<0.001
Duration of total block	787.07	61.62	1002.67	43.54	-15.651	<0.001



At all time intervals between 5 min and 180 min, Ramsey sedation score of Group B was found to be higher than that of Group A and between group difference in Ramsey sedation score was found to be statistically significant at all periods of observation during 10 min and 180 min. At 4 hour and thereafter at each period of observation till 24 hours, Ramsey sedation score of all the patients of Group A and Group B was 2, median and mean Ramsey Sedation score of both the groups were 2.00 and 2.00±0.00 and were found to be similar.

DISCUSSION

Different types of modalities are available for providing anesthesia for upper limb surgeries. General anaesthesia, regional nerve blockes, bier's block, monitored anaesthesia care, supraglottic airway devices etc. Peripheral nerve blocks with advancement of peripheral nerve stimulator and ultrasound guided techniques became more specific and accurate with less number of complications with technique. As it offers anaesthesia by blocking specific region, it provides early ambulation and recovery. In our study we have assessed sixty patients belonging to ASA physical status I and II, posted for upper limb surgeries under supraclavicular brachial plexus block by using two different drug combinations i.e. bupivacaine 0.5% with dexmedetomidine (30 µg) (group BD) and levobupivacaine 0.5% with dexmedetomidine (30 µg) (group LD). There has been many studies comparing the efficacy of bupivacaine or levobupivacaine, but not many studies have been done comparing the efficacies of these two drugs with adjuvant dexmedetomidine in a single study. Hence, the present study. For BPB we have different approaches like interscalene, supraclavicular, infraclavicular. But when we compare all techniques supraclavicular block was found to be associated with less complications and higher sensory and motor blockade. Dewees *et al.* compared to interscalene block (ISB) to supraclavicular block (SCB) observed higher incidence of complete sensory and motor block with supraclavicular block and lower incidence of complications. Lanz *et al.* found that supraclavicular block results in more homogenous block compared interscalene block which causes preferential block of cephalad portions and axillary block which blocks caudal portions. Baranowski *et al.* observed a positive correlation between numbers of paresthesia sought and peripheral nerve block success rate. Levobupivacaine is a newer drug which is stereoisomer of bupivacaine. Various published studies show that levobupivacaine is a safer drug than bupivacaine as it is less cardiotoxic. In previous studies, it was observed thatbupivacaine and levobupivacaine provide almost similar block characteristics for BPB.

In our study, In both the groups MAP was found to be lower than that at baseline (0 min) at all the periods of observation from 5 min to 24 h. In both group A and group B, change in MAP from baseline was found to be statistically significant at all the periods of observation. Onset of sensory block was early in Group B (6.45±0.91 minutes) as compared to Group A (8.02±0.82 minutes) ($p<0.001$). Duration of sensory block was statistically significantly longer in Group B (891.50±68.38 min) as compared to Group A (756.67±64.68 min). Onset of motor block also was early in Group B (9.02±0.90 min) as compared to Group A (10.01±0.88 min.) ($p<0.005$). Duration of motor block was statistically significantly longer in Group B (788.83±62.97 min) as compared to Group A (700.67±64.67 min). Duration of analgesia was statistically significant and longer in Group B (1002.67±43.54 min) as compared to Group A (787.07±61.62 min) i.e. when the patient's VAS score was ≥ 4, rescue analgesia was given by surgical team thereafter. Recently, Kaygusuz *et al* evaluated the addition of dexmedetomidine 1 µg/kg to 0.5% levobupivacaine in axillary BPB and observed significantly decreased sensory block onset time, an increase in the sensory and motor block duration and time to first-analgesic use, and decreased total analgesic use with no side effects.

Esmaoglu *et al.* demonstrated lower intraoperative MAP and HR values in group D (levobupivacaine and dexmedetomidine) then group L (levobupivacaine) ($P<0.05$). Postoperative MAP and HR values at 10 and 30 minutes and 1 and 2 hours were lower in group D ($P< 0.01$). However, no patient experienced any episode of hypotension, bradycardia or hypoxemia that required treatment during either intraoperativ or postoperative period. Swami *et al* used dexmedetomidine and clonidine as an adjuvant to bupivacaine 0.25% in supraclavicular plexus block and demonstrated that dexmedetomidine prolongs the duration of sensory and motor block and enhances the quality of block as compared with clonidine. In our study, the supraclavicular block was given with the peripheral nerve stimulator. There were no complications observed either due to block technique or the drugs. There were also no cases of sensory or motor deficits persisting beyond 24 hrs. Kwon et al. conducted a study to evaluate the sedative effect of dexmedetomidine added to ropivacaine for supraclavicular brachial plexus block (BPB) using the bispectral index (BIS). Sixty patients undergoing wrist and hand surgery under supraclavicular BPB were randomly allocated to two groups. Ultrasound-guided supraclavicular BPB was performed with 40 ml of ropivacaine 0.5% and 1 µg/kg of dexmedetomidine (Group RD) or 0.01 ml/kg of normal saline (Group R). They concluded that dexmedetomidine added to ropivacaine for brachial plexus block induced sedation that corresponds to a BIS value of 60 from which patients are easily awakened in a lucid state. In addition, perineural dexmedetomidine shortened the onset time and prolonged the duration of the sensory and motor blocks.

In our study at baseline, Ramsay sedation score of all the patients of both the groups was 2. At all periods of observation Ramsay sedation score of Group B was found to be higher than that of Group A. In our study none of the patients were given any anxiolytic or sedative-hypnotic either as premedication or intra-operatively, despite this the Ramsay sedation score was found to be better in group LD. This property of drugs in our study helped in better patient's cooperation during intra and post-operative period without use of any sedative-hypnotic. However, prolonged motor block is still a matter of concern and the search for adjuvant that selectively prolongs analgesia without impairing motor function continues.

Limitations of the study

- Small sample size
- A placebo-control group was not there.
- Surgeon's and patient's satisfaction scores were not taken into the consideration.

Conclusion

The observations were subjected to statistical analysis and following conclusions were drawn:

- Dexmedetomidine with levobupivacaine provides early onset of sensory blockade and longer duration of analgesia.
- The onset of motor blockade was early and its duration was significantly prolonged with dexmedetomidine and levobupivacaine.
- Dexmedetomidine as an adjuvant to either bupivacaine or levobupivacaine resulted in clinincally non-significant changes in hemodynamic parameters i.e. (HR, MAP).

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