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A randomized double blind prospective study to compare the characteristics of levobupivacaine with clonidine or dexmedetomidine as an adjuvant in supraclavicular brachial plexus block

Anaesthesiology

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ABSTRACT

Background and Aims: For early onset and prolonged postoperative analgesia various adjuvants are used with local anaesthetic agents in brachial plexus block. The aim of this study was to compare the effects of clonidine and dexmedetomidine as an adjuvant in brachial plexus blocks.

Methods: In present study 25 cases were taken for each group.

Group I (n=25) Control group = received 28 ml levobupivacaine 0.5%.

Group II (n=25) received 28 ml levobupivacaine 0.5% plus 1 mcg/kg clonidine.

Group III (n=25) received 28 ml levobupivacaine 0.5% plus 1 mcg/kg dexmedetomidine.

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Group III (n=25) received 28 ml levobupivacaine 0.5% plus 1 mcg/kg dexmedetomidine.

All the solutions were diluted with normal saline to make a total volume of 30 ml.

The brachial plexus block with classical supraclavicular approach was given. Observations including hemodynamic variables (heart rate, blood pressure, respiratory rate and o2 saturation), onset and duration of sensory and motor block, duration of analgesia and degree of sedation were noted.

Results: The difference in onset of sensory & motor block (early in dexmedetomidine group), duration of sensory & motor block and duration of analgesia (prolonged in dexmedetomidine group) was found to be statistically significant between all the groups ($p<0.05$).

Effect on hemodynamic vitals was found significant between group I and group III & group II and III. No significant difference between group I and group II is seen. There was no incidence of clinically significant hypotension, bradycardia in the perioperative period in any of group and no active intervention was required.

The degree of sedation was slightly more in dexmedetomidine group.

Conclusion: The supraclavicular brachial plexus block with dexmedetomidine adjuvant caused early onset of sensory and motor blockade and is highly effective in prolonging the duration of sensory and motor blockade and postoperative analgesia with better quality of block as compared to levobupivacaine alone or with clonidine as adjuvant.

KEYWORDS:

Brachial plexus block, supraclavicular, levobupivacaine, clonidine, dexmedetomidine.

INTRODUCTION

Brachial plexus block serves as the sole regional anaesthetic technique to facilitate painless surgery in the upper limb and is close to the ideal anaesthetic technique. It provides an excellent alternative for the patients who are at high risk for general anaesthesia.

Various approaches have been described for brachial plexus block of which the supraclavicular approach is the most consistent and time efficient as it blocks all the branches of the brachial plexus. It has a high success rate and rapid onset of action. It provides analgesia without sedation, prolonged postoperative analgesia and allows early patient's discharge. Pneumothorax (1-6%), hemothorax, horner's syndrome and phrenic nerve block are the potential complications (1, 2).

For early onset of block, for prolonged postoperative analgesia and for reducing the requirement of local anaesthetic agents various adjuvants are used. Clonidine & dexmedetomidine are commonly used adjuvant in brachial plexus blocks (6,7,8).

AIM OF THE STUDY: To compare the effect of 0.5% levobupivacaine with or without clonidine 1µg/kg or dexmedetomidine 1µg/kg on the onset and duration of sensory & motor block, duration of analgesia, hemodynamic parameters (heart rate, blood pressure, respiratory rate and oxygen saturation) and degree of sedation in brachial plexus blocks.

METHODOLOGY

This was a hospital based prospective interventional randomized double blind controlled study.

Study was approved by the research and review board of our medical college. Due permission from the institutional ethical committee was taken and informed written consent from all the patients undergoing study was also obtained before the study.

All patients (male/female) were of ASA class 1 or 2, 50-70 kgs. of weight, 20-50 years of age, undergoing elective surgery on upper limb which took 1-2 hours duration. Patients with history of respiratory distress and/or contralateral pneumothorax were excluded from the study.

Sample size: As in study of Sarita Swami et al (10) expecting minimum detectable difference in mean duration of analgesia in both the group 166.54 with SD 97.99 minutes, the sample size was calculated 19 subjects for each group at alpha error 0.05 and power 90%. In our study we included 25 patients in each group.

Group I (n=25) Control group = received 28 ml levobupivacaine 0.5%.
Group II (n=25) received 28 ml levobupivacaine 0.5% and 1 mcg/kg clonidine as an adjuvant.
Group III (n=25) received 28 ml levobupivacaine 0.5% and 1 mcg/kg dexmedetomidine as an adjuvant.

All the solutions were diluted with normal saline to make a total volume of 30 ml.

The patients were randomly assigned into either group using a computer generated randomisation list. Patients, surgeons and anesthesiologist who were involved in the patient's clinical assessment and treatment were blinded to the group assignment.

The brachial plexus block with classical supraclavicular approach was given in all the patients. Vitals (heart rate, blood pressure, respiratory rate and oxygen saturation) were recorded at 5 minutes interval in first hour and hourly thereafter.

After injecting the drug sensory block was tested by pin prick and motor block by ability to move the upper limb, in every 5 minutes till the onset of block. Onset of sensory block was defined when there is no pin prick sensation in shoulder area & motor block onset is defined when patient was unable to move shoulder joint. Time to onset of sensory & motor block was recorded.

Duration of sensory block was considered the time from loss of pin prick sensation to return of this sensation. Duration of motor block was taken as time between onset of motor block to return of movements at elbow joint.

Duration of sensory & motor block and duration of analgesia (VAS score) with degree of sedation (Table 3) were also recorded.

The assessment was made for a maximum of 35 min and if no block was established, it was labeled as a "failed" block and general anesthesia was given. If the patient felt any pain during the procedure, the blocks were supplemented using injection ketamine 1 mg/kg and were recorded as partial block and were excluded from study.

Pain score (visual analogue score) was recorded at 1,6,12 and 18 hours after completion of the surgery. When VAS recorded was >3, inj. diclofenac 75 mg was given intramuscularly as rescue analgesic and considered as duration of analgesia.

A close monitoring of the patients was done throughout the procedure to look for any other complication.

Statistical Analysis: Collected data were analyzed using 'Primer' software. Quantitative data was expressed as mean ± SD. To assess any significant association ANOVA test and Tukey test were used. Significance level was considered at $p<0.05$.

RESULTS

In this study satisfactory surgical anaesthesia was attained in all the cases.

The **demographic and baseline hemodynamic parameters** were comparable in all the groups ($p>0.05$) (Table 1).

The mean **onset of sensory block** for Group I was 10.16±1.027 (min.), for Group II was 8.64±0.994 (min.) and for Group III was 7.04±0.734 (min.). This difference between all the groups was found to be statistically very significant ($p<0.01$).

The mean **onset of motor block** for Group I was 11.6±1.04 (min.), for Group II was 10.04±0.978 (min.), and for Group III was 8.32±0.690 (min.). This difference was found to be statistically significant between all the groups ($p<0.05$).

Table 1: Demographic data and baseline hemodynamic variables

	Group I	Group II	Group III	ANOVA
				p Value
Age (years)	32.76 ±9.93	30.24 ±6.882	32.76 ±9.089	0.503
Weight (kg)	56.96 ±5.511	57.52 ±5.197	58.68 ±5.039	0.501
Heart Rate	81.125 ±6.628	79 ±7.382	78.56 ±7.065	0.391
Systolic BP	121.90 ±7.931	119.5 ±5.546	121 ±5.062	0.401
Diastolic BP	79 ±5.656	76.88 ±4.265	76.8 ±4.924	0.215
Respiratory Rate	15.04 ±0.954	14.88 ±0.832	15 ±1.471	0.871
SPO2	97.9 ±1.02	97.6±1	97.7 ±0.98	0.561

Values are (Mean ± SD)

The mean **duration of sensory block** in Group I was 589.2±27.525 (min.), in Group II was 697.2±26.223 (min.) and in Group III was 809.6±23 (min). On applying ANOVA test p was <0.01 (statistically significant).

The mean **duration of motor block** in Group I was 478.4±24.097 (min), in Group II was 586.4±22.891 (min.) and in Group III was 698±22.173 (min.).The p value was <0.01 between the groups (significant).

The mean **duration of analgesia** in Group I was 749.6±27.61 minutes, in Group II was 846.4±21.77 minutes and in Group III was 970.8±23.43 minutes. The p value was <0.01 between the groups (statistically significant).

Table 2: Block (Sensory & motor) and Analgesia

	Group I	Group II	Group III	ANOVA	P value (Turkey's test)		
					I & II	I & III	II & III
Onset of Sensory Block (min.)	10.16 ±1.027	8.64 ±0.994	7.04 ±0.734	<0.01	<0.05	<0.05	<0.05
Onset of Motor Block (min.)	11.6 ±1.04	10.04 ±0.978	8.32 ±0.690	<0.01	<0.05	<0.05	<0.05
Duration of Sensory Block (min.)	589.2 ±27.525	697.2 ±26.223	809.6± 23	<0.01	<0.05	<0.05	<0.05
Duration of Motor Block (min.)	478.4 ±24.097	586.4 ±22.891	698 ±22.173	<0.01	<0.05	<0.05	<0.05
Duration of analgesia (min.)	749.6 ±27.61	846.4 ±21.77	970.8 ±23.43	<0.01	<0.05	<0.05	<0.05

Values are (Mean ± SD)

Effect on **heart rate, systolic & diastolic BP** (intraoperative & postoperative)**:** Turkey's test was applied and found significant difference between group I and III & group II and III ($p<0.05$). No significant difference between group I and II was seen ($p>0.05$).

Effect on **respiratory Rate & oxygen saturation**: Turkey's test was applied and found no statistically significant difference ($p>0.05$) in intraoperative and postoperative period.

Effect on **degree of sedation:** Patient who received clonidine or dexmedetomidine got some degree of sedation as shown in Table 3. No patient in any group was very drowsy (unresponsive to pain) or unresponsive.

There was no respiratory depression, nausea, vomiting or any other **adverse effect** in any patient in the intraoperative and postoperative period.

Table 3: Degree of sedation

S No	Duration of sedation	Group 1	Group 2	Group 3
1	Awake and alert	25	14	7
2	Drowsy but responsive to command	0	11	18
3	Very drowsy but responsive to pain	0	0	0
4	Unresponsive to pain	0	0	0

DISCUSSION

Various adjuvants are used in peripheral nerve blocks for reducing dose of local anaesthetic agents, decreasing onset time of block, prolonging duration of sensory & motor block and postoperative analgesia.

Clonidine & dexmedetomidine are selective alpha-2 agonists, when added to local anaesthetic agents improves efficacy and potency of peripheral nerve blocks(6,7,8). Dexmedetomidine is considered to have eight times more selective affinity for α_{2A} and α_{2C} receptors as compared to clonidine(13).

First, it has been suggested that it may exert an independent effect on neural transmission similar to that of local anesthetics. They inhibit C fibers (pain) with a much greater degree than Aα (motor conduction) and have a direct depressant effect on them(4,14). Secondly, it has been suggested that α_2 agonists may exert vasoconstriction at the site of injection by activation of postsynaptic adrenergic receptors thus prolonging sensory and motor blockade by decreasing the systemic absorption of local anaesthetic compounds. However, this has been disproved by a recent study of Langer et al(3).

The results of this study show that there was significantly early onset of sensory and motor block when clonidine or dexmedetomidine were added to levobupivacaine. Duration of sensory & motor block and duration of post operative analgesia were also significantly prolonged with clonidine or dexmedetomidine.

Santvana Kohli et al(12) & Bernard et al(5) found that clonidine decrease the onset of sensory and motor block and increase the duration of sensory and motor block and post operative analgesia as compared to bupivacaine and lidocaine alone, which is also consistent with our study.

Among two α_2 agonists, in our study time required for onset of sensory and motor block was significantly less in the dexmedetomidine group than in the clonidine group. Duration of sensory and motor block and duration of post operative analgesia were also significantly prolonged in dexmedetomidine group in comparison to clonidine group.

These results are consistent with the studies of Aliye Esmaoglu et al(8), Rachana et al(9) and Kenan et al(11), where dexmedetomidine was found to decrease the time of onset of sensory & motor block and increase the duration of sensory and motor block and post operative analgesia compared to bupivacaine alone.

Contrary to our study, Sarita Swami et al(10) found that no significant difference was seen in the onset of block with dexmedetomidine and clonidine when added as an adjuvant. They compared the effects of clonidine and dexmedetomidine added to bupivacaine in supraclavicular brachial plexus block & concluded that dexmedetomidine enhance the duration of sensory and motor block and also the duration of analgesia compared to clonidine which is similar to our study results.

Saumya et al(16) studied effects of dexmedetomidine added to levobupivacaine in supraclavicular brachial plexus block and found that dexmedetomidine prolongs the duration of block & postoperative analgesia, which is also similar to our study.

In our study we observed no clinical or statistical significant changes in hemodynamic variables (heart rate, blood pressure, oxygen saturation & respiratory rate) when clonidine or dexmedetomidine were added as adjuvant to levobupivacaine except mild sedation. No active intervention was required in any patient. Mild sedation is because of some amount of systemic absorption of $\alpha_2$agonist drug(5).

Chakraborty et al(15) evaluated the effect of clonidine as an adjuvant in bupivacaine-induced supraclavicular brachial plexus block and observed the prolonged duration of analgesia with clonidine without producing any clinically important adverse reactions other than sedation.

This shows that dexmedetomidine is appropriate for brachial plexus block and in fact superior to clonidine as an adjuvant to levobupivacaine.

Conclusion: Supraclavicular brachial plexus block with levobupivacaine and dexmedetomidine causes early onset of sensory & motor block. It is highly effective in prolonging the duration of sensory & motor block and postoperative analgesia with better quality of block as compared to levobupivacaine with or without clonidine. No significant side effects were noted. So dexmedetomidine is better adjuvant than clonidine in supraclavicular brachial plexus block.

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Conflicts of interest: Nil

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