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Evaluation in Supraclavicular Brachial Plexus Block between Dexmedetomidine and dexamethasone as an Adjuvant to Local Anesthetic: A Double-Blind Prospective Study

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Abstract

Background: Supraclavicular brachial plexus block is a commonly employed regional nerve block technique for upper extremity surgery. Various adjuvants were added tolocal anesthetics in brachial plexus block to achieve rapid onset and prolonged block. *Objective:* To compare dexamethasone and dexmedetomidine as an adjuvant to local anesthetic agent in supraclavicular brachial plexus block with respect to onset and duration of sensory and motor block. *Methods:* Forty ASA I and II patients scheduled for elective upper limb surgeries under supraclavicular brachial plexus block were divided into two equal groups in a double-blinded fashion. Group one was given 0.25% Bupivacaine 2 milligram/kg aslocal anesthetic and Dexmedetomidine 1 microgram/kg as adjuvant. Group two was given 0.25% Bupivacaine 2 milligram/kg and Dexamethasone 100 microgram/kg as adjuvant. Onset and duration of sensory and motor blockade and hemodynamic stability were recorded. All patients were observed for any side effects and complications. All data were recorded, and statistical analysis was done. *Results:* Sensory block and motor block onset was earlier in dexmedetomidine group. The duration of blockade was also prolonged in dexmedetomidine group when compared with dexamethasone group and is not associated with any major side-effect. *Conclusion:* Dexmedetomidine is a better adjuvant than dexamethasone in supraclavicular brachial plexus block.

Keywords: Dexmedetomidine; Dexamethasone; Bupivacaine; Supraclavicular brachialplexus block.

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Introduction

Brachial plexus block is a popular and widely employed regional nerve blocktechnique for perioperative anesthesia and analgesia for surgery of the upper extremity. Various approaches have been described such as supraclavicular, interscalene, transscalene, infraclavicular and axillary. Supraclavicular approach is the easiest and most consistent method for surgery below the shoulder joint. Regional nerve block minimizes the stress response and using minimal anesthetic drugs is always beneficial for the patients with various cardio- respiratory comorbidities.[1] Local anesthetics alone for Supraclavicular brachial plexus block

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providegood operative conditions but have shorter duration of post-operative analgesia. Bupivacaine is used frequently for supraclavicular nerve block as it has long duration of action from *3* to *6 hr*. So, various adjuvant like opioids, clonidine, neostigmine, midazolam, dexamethasone etc. were added to local anesthetics in brachial plexus block to achieve quick, dense and prolonged block, but the results are either in conclusive or associated with side effects.[2] Dexmedetomidine is highly specific to α-2 adrenoceptors, yielding an α-2/α-1 ratio of 1620 6. In humans, dexmedetomidine has shown to prolong the duration of block and post-operative analgesia when added to local anesthetic in various regional blocks.[3–6] Dexmedetomidine when added to bupivacaine for supraclavicular brachial plexus block shortens the onset times for sensory and motor blocks and prolongs their duration. The significantly prolonged duration of analgesia obviates the need for any additional analgesics.[7] Addition of *8 mg* dexamethasone to bupivacaine 0.25% solution in supraclavicular brachial plexus block prolongs the duration of sensory and motor blockade, reduces the requirement of rescue analgesic in post-operative period.[8] So, the rationale behind the study was to test the hypothesis that dexmedetomidine when added as an adjuvant to local anesthetic in supraclavicular brachial plexus block enhanced the duration of sensory and motor block, duration of analgesia and quality of block as compared with dexamethasone.

Materials and Methods

Study design

A double-blind prospective study.

Study setting

Tertiary care teaching hospital-major operation theatre, Dept of Anesthesiology, Pushpagiri Institute of Medical Sciences, Tiruvalla, Kerala.

Study Population

40 patients of the age group *18–60 years* belonging to ASA Grade I and II who were posted for upper limb orthopedic surgeries under supraclavicular brachial plexus block. Selection was based on inclusion and exclusion criteria.

Sample size

With 80% power and 95% confidence, assuming equal number in both groups, to estimate a difference of *four hours* of sensory and motor blockade between dexmedetomidine and dexamethasone with pooled variants of 16, a sample size of 17 per group was estimated. For accounting drop outs the sample size is rounded to 20.

Inclusion criteria

1. Age between *18–60 years*.
2. Physical status American Society of Anesthesiologist (ASA) I and II.

Exclusion criteria

1. ASA grade more than two.
2. Known hypersensitivity to local anesthetic drugs.
3. Bleeding disorders.
4. Pregnant women.
5. Pre-existing peripheral neuropathy.
6. Patients already on dexamethasone or any adrenoceptor agonist/antagonist.

Ethical Considerations

The study was conducted after attaining approval from research and ethical committee of Pushpagiri Institute of Medical sciences, Tiruvalla.

Informed consen

Written informed consent was taken from all patients.

Methodology

Patients were assigned to two groups of 20 each as follows:

Goup 1: Dexmedetomidine group. Injection 0.25% Bupivacaine *2 milligram/kg* as local anesthetic an Dexmedetomidine *1 microgram/kg* as adjuvant.

Group 2: Dexamethasone group. Injection 0.25% Bupivacaine *2 milligram/kg* and Dexamethasone *100 microgram/kg* as adjuvant.

Pre-operative evaluation

A thorough pre-anesthetic check-up was carried out. Detailed history was taken, airway and systems were examined. Pulse rate, blood pressure and body weight were noted.

Pre-operative preparation

All patients were kept fasting for *eight hours* before

surgery. All the subjects were premedicated with Tab. Ranitidine *150 mg* Tab. Alprazolam *0.25 mg* on previous night and *two hours* prior to surgery.

Procedure

After allowing the patients to settle down in the operative room for a period of *five minutes*, baseline parameters like heart rate, blood pressure, and oxygen saturation were measured and recorded. All the patients were given brachial plexus through supraclavicular approach by an experienced anesthesiologist different from one assessing the patient intra and post-operatively. Each patient was made to lie supine, arms at the side, head turned slightly to the opposite side. The supraclavicular area was a septically prepared and draped. The tip of the index finger placed in the supraclavicular fossa directly over the subclavian artery pulsation which is used as the landmark. The pulsation can be felt in a plane just medial to the midpoint of the clavicle. After a skin wheal with local anesthetic approximately *1 cm* above the midclavicular point, the stimuplex needle is introduced through the skin and directed just above and posterior to the subclavian pulse and advanced slowly in caudal, medial and posterior directions. The nerve stimulator is initially set at 1.0 to 1.2 Ma. The needle is advanced until flexion of fingers is noted. If contraction is still observed with the nerve stimulator voltage decreased to *0.5 mA*, the local anesthetic solution is injected after confirming negative aspiration of blood. Onset and duration of sensory and motor blockade and hemodynamic stability were measured and recorded at specified time intervals. Sensory block was assessed by the pin prick method. Assessment of sensory block was done in the dermatomal areas at specified time intervals after completion of drug injection. Sensory onset was considered when there was a dull sensation topin prick.

Sensory block was Graded as:

Grade 0: Sharp pin felt.

Grade 1: Analgesia, dull sensation felt.

Grade 2: Anesthesia, no sensation felt.

Assessment of motor block was carried out by the same anesthesiologist at specified time intervals till complete motor blockade after drug injection. Onset of motor blockade was considered when there was Grade 1 motor blockade. Motor blockade was determined according to a modified Bromage scale for upper extremities on a 3-point scale:

Grade 0: Normal motor function with full flexion and extension of elbow, wrist and fingers.

Grade 1: Decreased motor strength with ability to move the fingers only.

Grade 2: Complete motor block with inability to move the fingers.

The duration of sensory block was defined as the time interval between complete injection of local anesthetic and when the patient first experienced pain in the post-operative period. The duration of motor block was defined as the time interval between complete administration of local anesthetic and complete recovery of motor function. All patients were observed for any side effects and complications.

Statistical Analysis

Collected data were compiled, entered and subjected to statistical analysis using Statistical Package for Social Sciences (SPSS) Version 20. For all statistical evaluation, an independent sample *t*-test was applied with probability value of < 0.05 was considered significant.

Results

Table 1: Age wise distribution of study participants

Group	Sample	Mean	Standard Deviation	P value
Dexmedetomidine	20	41.20	14.443	0.22>0.05
Dexamethasone	20	36.00	11.938	

As per shows in (**Table 1**) Mean age in Group 1 (Dexmedetomidine) and Group 2 (Dexamethasone) were *41.20 ± 14.443 years* and *36.00 ± 11.938 years* respectively. This difference in the ages between the two Groups was statistic indicates that the two Groups are more or less homogenous with respect to age and are hence comparable.

Table 2: Gender wise distribution of the study participants

Group	Percentage	
	Male	Female
Dexmedetomidine	65	35
Dexamethasone	50	50

There is no significant difference (p – value = 0.337 > 0.05) between Group 1 (Dexmedetomidine) and Group 2 (Dexamethasone) with respect to gender of the patients included in the study. This indicates that the two Groups are more or less homogenous with respect to gender andare hence comparable.

Onset of sensory block was earliest in Group 1 (Dexmedetomidine) and this was statistically significant when compared to Group 2 (Dexamethasone) (p – value = 0.024 < 0.05). though the mean values of Group 1 is higher than Group 2.

Onset of motor block was earliest in Group 1 (Dexmedetomidine) and this was statistically significant when compared to Group 2 (Dexamethasone) (p - value = 0.006 < 0.01).

Mean duration of sensory block was higher in Group 1 (Dexmedetomidine) and this was statistically significant when compared to Group 2 (Dexamethasone) (p – value = 0.003 < 0.01). Mean values are higher in Group 1 as compared to Group 2.

Mean duration of motor block was higher in group 1 (Dexmedetomidine) and this was statistically significant when compared to Group 2 (Dexamethasone (p – value = 0.018 < 0.05).

Comparison of baseline Heart rate in the two groups indicates that there is no significant difference between the two Groups. The mean heart rate is lower in Group 1 (Dexmedetomidine) as compared to Group 2 (Dexamethasone) at *zero minute*, *five minutes*, *ten minutes*, *twenty minutes*, *forty minutes*, *sixty minutes*, *eighty minutes*, *hundred minutes* and *one hundred* and. Statistical analysis proved that there is significant difference in mean heart rate of the two Groups at various time periods (p – value < 0.05).

Table 3: Onset of sensory block

Group	Sample	Mean	Standard Deviation	T value (with degrees of freedom)	P value
Dexmedetomidine	20	11.40	3.575	2.343 (38)	0.024<0.05
Dexamethasone	20	14.45	4.594		

Table 4: Onset of motor block

Group	Sample	Mean	Standard Deviation	T value (with degrees of freedom)	P value
Dexmedetomidine	20	15.57	4.475	2.918 (38)	0.006<0.01
Dexamethasone	20	20.25	5.159		

Table 5: Duration of Sensory Block

Group	Sample	Mean	Standard Deviation	T value (with degrees of freedom)	P value
Dexmedetomidine	20	1005.10	201.814	3.206 (38)	0.003<0.01
Dexamethasone	20	823.75	152.530		

Table 6: Duration of Motor Block

Group	Sample	Mean	Standard Deviation	T value (with degrees of freedom)	P value
Dexmedetomidine	20	983.10	196.756	2.465 (38)	0.018<0.05
Dexamethasone	20	833.25	187.633		

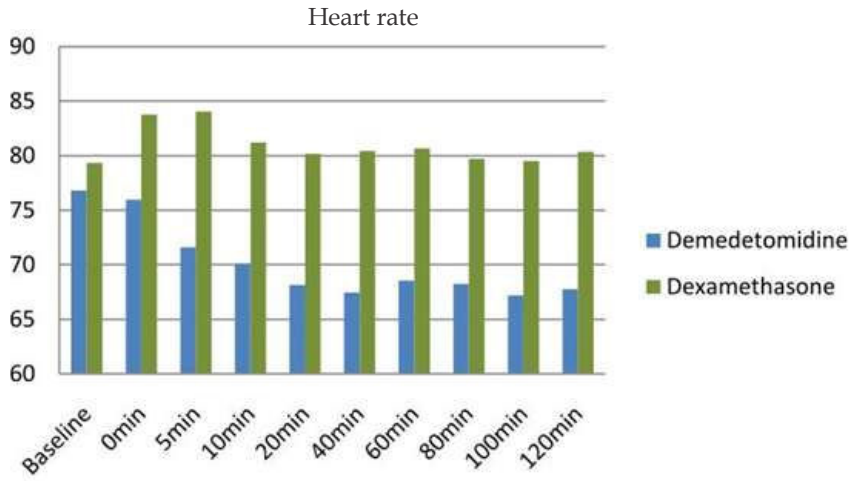

Fig. 1: Comparison of Heart rate among two groups

Discussion

The brachial plexus block for upper limb surgery has proved to be a safer and effective method of regional anesthesia. But it is a common observation that surgeries on upper limb are still being performed mainly under general anesthesia despite unanimous consensus toward regional anesthesia, due to one or the other reasons.Various approaches have been described such as supraclavicular, interscalene, trans scalene, infraclavicular and axillary, but they all are associated with some technical difficulties, in-adequate blocks and significant complications. The rate of conversion or supplementation with general anesthesia from brachial block is quite high. The supraclavicular block of the brachial plexus has many advantages over other approaches to brachial plexus block 33, 34, 35. It has the reputation of providing most complete and reliable anesthesia for upper limb surgery. It is performed at the trunk level where the plexus is presented most compactly.

Our study revealed that mean ages in Group 1 (Dexmedetomidine) and Group 2 (Dexamethasone) were *41.20 ± 14.443 years* and *36.00 ± 11.938 years* respectively. This difference in the ages between the two Groups was statistically not significant (*p* – value = 0.22 > 0.05).

In our study, there were 13 male patient and 7 female patients in Group 1 (Dexmedetomidine) and 10 male and 10 female patients in Group 2 (Dexamethasone). Our study revealed that there is no significant difference (*p* – value = 0.337 > 0.05) between Group 1 (Dexmedetomidine) and Group 2 (Dexamethasone) with respect to gender of the patients included in the study.

In our study, mean of onset of sensory block in Group 1 (Dexmedetomidine)is *11.40 ± 3.575 minute* and in Group 2 (Dexamethasone) is *14.45 ± 4.594 minute*. Onset of sensory block was earliest in group 1 (Dexmedetomidine) and this was statistically significant when compared to Group 2 (Dexamethasone) (*p* - Value = 0.024 < 0.05).

In our study, mean duration of motor block in Group 1 (Dexmedetomidine) is *983.10 ± 196.756 minute* and in Group 2 (Dexamethasone) *833.25 ± 187.633 minute*. Mean duration of motor block was higher in Group 1 (Dexmedetomidine) and this was statistically significant when compared to Group 2 (Dexamethasone) (*p* – value = 0.018 < 0.05).

Our study revealed that with use of dexmedetomidine there was a mean heart rate change from baseline of *76.80 ± 11.985 beats per minute to 75.95 ± 11.578 beats per minute* at zero minute. Mean heart rate at *five minutes*, *ten minutes*, *twenty minutes*, *forty minutes*, *sixty minutes*, *eighty minutes*, *hundred minutes* and *one hundred* and *twenty minutes* were *71.6 ± 11.413*, *70.10 ± 10.290*, *68.15 ± 10.277*, *67.45 ± 10.149*, *68.55 ±11.180*, *68.25 ± 11.088*, *67.20 ± 10.670*, *67.75 ± 10.467 beats/minute* respectively. With use of dexamethasone there was a mean heart rate change from baseline of *79.35 ± 13.967 beats per minute* to *83.75 ± 14.825 beats per minute* at zerominute. Comparison of baseline heart rate in the two Groups indicates that there is no significant difference between the two Groups. The mean heart rate is lower in Group 1 (Dexmedetomidine) as compared to Group 2 (Dexamethasone) at *zero minute, five minutes*, *ten minutes*, *twenty minutes, forty minutes*, *sixty minutes*, *eighty minutes*, *hundred minutes* and *one hundred* and twenty minutes. Statistical analysis proved that there is significant difference in mean heart rate of the two groups at various time periods (*p* - value < 0.05).

Swami *et al.* in 2012 concluded that dexmedetomidine (*1 µg/kg*) when added to local anesthetic (bupivacaine 0.25%) in supraclavicular brachial plexus blocken hanced the duration of sensory and motor block and also the duration of analgesia.[9] Zhang *et al.* in 2014 also reported prolonged sensory and motor blockade duration patients who received dexmedetomidine.[10] Agarwal, *et al.* concluded, that dexmedetomidine when added to bupivacaine for supraclavicular brachial plexus block shortens the onset times for sensory and motor blocks and prolongs their duration. The significantly prolonged duration of analgesia the need for any additional analgesics. The added advantage of conscious sedation, hemodynamic stability, and minimal side effects makes it a adjuvant for nerve blocks.[7] Kathuria, *et al.* In 2015 concluded that in supraclavicular brachial plexus block addition of dexmedetomidine as adjuvant shortens the sensory and motor block onset time, prolongs both sensory and motor block duration. It also significantly delays the first demand for analgesia supplementation, decreases *24 hr* analgesic consumption and is not associated with any major side-effect. The action of dexmedetomidine is most probably peripheral than centrally mediated.[11]

Gandhi *et al.* reported that dexmedetomidine has better hemodynamic stability and greater post-operative analgesia.[12] Shrestha *et al.* reported that dexamethasone when added as adjuvant tomixture

of local anesthetics resulted in significantly early onset and longer duration of analgesia.[13]

Conflict of Interest: None declared

Source of Funding: None

Conclusion

We conclude that in supraclavicular brachial plexus block addition of dexmedetomidine as adjuvant to 0.25% bupivacaine shortens the sensory and motor block onset time, prolongs both sensory and motor block duration and is not associated with any major side-effect. The added advantage of conscious sedation and hemodynamic stability makes it a potential adjuvant for nerve blocks. Thus, it can be concluded that dexmedetomidine is a better adjuvant than dexamethasone in supraclavicular brachial plexus block.

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