

Original Research Article

An evaluation of the efficacy of adding clonidine as adjuvant to bupivacaine as compared to dexmedetomidine as adjuvant to bupivacaine in supraclavicular brachial plexus blocks for upper limb surgeries

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Abstract

Background: Local anesthetic, bupivacaine, is the most common agent used for spinal anesthesia but has a relatively short duration of action. Many adjuvants to local anesthetics have been used intrathecally to improve the quality of intra-operative analgesia and prolong it in the postoperative period. Opioids are commonly used as intrathecal adjuvants without significant motor or autonomic blockade. However, side effects such as pruritus, nausea, vomiting, urinary retention, and delayed respiratory depression have prompted further research toward non-opioid analgesics with lesser side effects.

Aim and objective: We compared clonidine and dexmedetomidine as an adjuvant to a local anesthetic agent in supraclavicular brachial plexus block concerning onset and duration of sensory and motor block and duration of analgesia.

Materials and methods: The study was conducted in the year 2019-2020 at Madras Medical College. Sixty ASAI and II patients scheduled for elective upper limb surgeries under supraclavicular brachial plexus block were divided into two equal groups in randomized, double-blinded fashion. Group C received clonidine 1µg/kg and Group D received dexmedetomidine 1

µg/kg added to bupivacaine 0.25% (40 ml). Onset and recovery time of sensory and motor block and duration of analgesia was studied in both groups.

Results: Duration of sensory block and motor block was 224.50 ± 32.70 and 307.70 ± 34.91 min, respectively, in group C, while it was 414.63 ± 70.35 and 489.16 ± 72.80 min, respectively, in group D. There was no statistically significant difference in onset of sensory block. The onset of motor block in group C was 5.66 ± 1.39 minutes. The onset of motor block in group D was 5.40 ± 1.88 minutes. The onset of motor block in group D was faster than group C; this difference was statistically significant. 'a value < 0.005 . The duration of analgesia (time to the requirement of rescue analgesia) in group D was 455.96 ± 71.34 min, while in group C, it was 263.10 ± 40.53 min. Statistically, this difference was significant ($P=0.001$).

Conclusion: We conclude that the addition of 1 µg/kg of dexmedetomidine to 0.25% bupivacaine accelerates the onset of sensory and motor block, prolongs the duration of sensory and motor block and the time for rescue analgesia with mild sedation without any adverse effects when compared to clonidine as an adjuvant to bupivacaine in supraclavicular brachial plexus blocks for upper limb surgeries.

Key words

Clonidine, Dexmedetomidine, Supraclavicular block.

Introduction

Peripheral nerve blocks provide optimal operating conditions when used ideally. They reduce the stress response to surgery and cause the least interference with the vital physiological functions of the body when compared to other conventional techniques. Brachial plexus block was first performed by William Stewart Halsted in 1889 A.D. Kulenkampff performed supraclavicular brachial plexus block in 1911 [1]. The main drawback of local anesthetic agents is the delayed onset of action, varying intensity of blockade, and inadequate post-operative pain relief. To overcome these drawbacks, various adjuvants were added with local anesthetic solutions [2]. Various opioid and non-opioid agents have been studied as adjuvants to brachial plexus blockade. Clonidine and Dexmedetomidine have shown a greater affinity for α_2 receptors. "This study aimed to compare the relative efficacy of Clonidine and Dexmedetomidine with Bupivacaine for intra-operative/ post-operative analgesia and safety [3]. The addition of alpha2 adrenergic agonist drugs is suggested to improve the local anesthetic effects by facilitation of C fiber blockade and local vasoconstriction or a

simple diffusion along the nerve or slow retrograde axonal transport in the spinal cord. Clonidine and dexmedetomidine possibly amplify the Na^+ channel blockade action of local anesthetic by opening up the K^+ channels resulting in membrane hyperpolarisation [4]. This study compares clonidine and dexmedetomidine as an adjuvant to bupivacaine for brachial plexus block by supraclavicular approach for orthopedic procedures of moderate duration using ultrasound guidance [5]. The Brachial Plexus is blocked at its most compact site (middle of Brachial Plexus) and it results in a homogenous spread of anesthetic drug to cause an early and complete block [6]. In clinical studies, adding clonidine or dexmedetomidine to local anesthetic solutions improved peripheral nerve blocks by quickening the onset time, improving the quality of block during surgery, and extending post-operative analgesia [7].

Materials and methods

The study was conducted in the year 2019-2020 at Madras Medical College. A prospective double-blinded randomized controlled study was conducted on 60 ASA I and II patients undergoing upper limb surgeries under

supraclavicular brachial plexus block who fulfill inclusion criteria. This study was started after getting institutional ethical committee approval and informed written consent from all the patients undergoing the study. They were randomly divided into 2 groups namely group C and group D. Group C (Bupivacaine + clonidine) – 30 patients received 38 ml of 0.25% Bupivacaine and 100 micrograms of clonidine Group D (Bupivacaine + dexmedetomidine) – 30 patients received 38 ml of 0.25% bupivacaine and 100 micrograms of dexmedetomidine.

Inclusion criteria: The following criteria were taken for including the patients in this study: ASA status I and II, Age between 16 and 60, Weight between 40 and 70 kg, Surgeries of moderate duration (60 to 90 minutes), Surgeries on the distal end of arm, forearm, and hand.

Exclusion criteria: Patient refusal, Known allergy for the drugs to be studied, Local infections/ sepsis, Coagulation abnormalities,

Alcohol/ drug abuse, Pregnant and lactating women, Patient receiving chronic analgesic therapy, Patients with severe cardiopulmonary disease, thyroid disorders, diabetes mellitus, and central or peripheral neuropathies, Other contraindications to regional anesthesia.

Statistical analysis

All the data were subjected to statistical analysis using Statistical Package for Social Sciences (SPSS), version 15. Duration of sensory and motor block and hemodynamic parameters were subjected to an independent t-test for statistical analysis. P-value < 0.05 was considered as statistically significant and P < 0.001 as highly significant.

Results

Comparison of age distribution between Group C (Clonidine with Bupivacaine) and Group D (Dexmedetomidine with Bupivacaine) was as per **Table – 1**.

Table – 1: Age distribution.

AGE	C GROUP	D GROUP	TOTAL	P value
16–20YRS	6	10	16	0.308
20-29YRS	9	7	16	
30-39YRS	5	6	11	
40-49YRS	7	4	11	
ABOVE50	3	3	6	
TOTAL	30	30	60	
Mean	33.33±14.55	29.13±12.59		

Comparison of hemodynamic parameters and sedation score between C and D groups was as per **Table – 2**. The mean pulse rate in group C was 79.26±6.72. The mean pulse rate in group D was 79.23±8.02. These rates were statistically comparable as per **Table – 3**.

The mean arterial pressure in group C was 75.100±7.74. The mean arterial pressure in group D was 71.43±5.23. These means were statistically comparable as per **Table - 4**.

The mean oxygen saturation in group C was 99.16±0.37. The mean oxygen saturation in group D was 99.03±0.31. These means were statistically comparable as per **Table - 5**.

The mean sedation score in group C was 1.00. The mean sedation score in group D was 2.00. These means were statistically significant as per **Table – 6**.

Table - 7 shows that the onset time of sensory blockade in group D was lesser than that of

group C. On statistical analysis, this difference was found to be insignificant. Mean duration of onset of action of sensory block in group C (clonidine with bupivacaine) compared with group D (dexmedetomidine with bupivacaine) motor blockade in group C (clonidine with bupivacaine) compared. The onset of the motor blockade in group C (clonidine with bupivacaine) was the time interval between administration of the drug and complete loss of muscle function.

Table – 2: Comparison of hemodynamic parameters and sedation score between C and D groups.

GROUP		N	Mean		Std. Deviation	'P' value
		Statistic	Statistic	Std. Error	Statistic	
C	Pulse rate	30	79.2667	1.22703	6.72070	Pulse rate = 0.166 Mean pressure = 0.095 Saturation = 0.139 Sedation score = 0.001
	Mean arterial pressure	30	75.1000	1.41369	7.74307	
	Saturation	30	99.1667	.06920	.37905	
	Sedation score	30	1.0000	.00000	.00000	
	Valid N (list wise)	30				
D	Pulse rate	30	79.2333	1.46506	8.02446	
	Mean arterial pressure	30	71.4333	.95615	5.23703	
	Saturation	30	99.0333	.05839	.31984	
	Sedation score	30	2.0000	.00000	.00000	
	Valid N (list wise)	30				

Table – 3: Comparison of pulse rate between group C and D.

Group	N	Mean		Std. Deviation	'P' Value
	Statistic	Statistic	Std. Error	Statistic	
C	30	79.2667	1.22703	6.72070	0.308
D	30	79.2333	1.46506	8.02446	

Table – 4: Comparison of mean arterial pressure between group C and group D.

GROUP	N	Mean		Std. Deviation	'P' value
	Statistic	Statistic	Std. Error	Statistic	
C	30	75.1000	1.41369	7.74307	0.095
D	30	71.4333	.95615	5.23703	

Table – 5: Comparison of oxygen saturation between group C and group D.

GROUP	N	Mean		Std. Deviation	'P' value
	Statistic	Statistic	Std. Error	Statistic	
C	30	99.1667	.06920	.37905	0.139
D	30	99.0333	.05839	.31984	

Table – 6: Comparison of sedation score between group C and group D.

GROUP	N	Mean		Std. Deviation	'P' Value
	Statistic	Statistic	Std. Error	Statistic	
C	30	1.0000	.00000	.00000	0.000
D	30	2.0000	.00000	.00000	

Table – 7: Comparison of onset of action of sensory block in group C (Clonidine with Bupivacaine) and group D (Dexmedetomidine with Bupivacaine).

GROUP	N	Mean		Std. Deviation	‘P’ value
	Statistic	Statistic	Std. Error	Statistic	
C - Onset of sensory block	30	2.8667	.14169	.77608	0.14
Valid N (list wise)	30				
D - Onset of sensory block	30	2.5333	.18404	1.00801	

Table – 8: Comparison of duration of sensory blockade.

GROUP	N	Mean		Std. Deviation	‘P’ value
	Statistic	Statistic	Std. Error	Statistic	
C- Duration of sensory block	30	224.5000	5.97018	32.70005	0.000
Valid N (list wise)	30				
D- Duration of sensory block	30	414.6333	12.84519	70.35598	
Valid N (list wise)	30				

Table – 9: Comparison of duration of action of motor block in group C (clonidine with bupivacaine) and group D (dexmedetomidine with bupivacaine).

GROUP	N	Mean		Std. Deviation	‘P’ value
	Statistic	Statistic	Std. Error	Statistic	
C - Duration of motor block	30	307.7000	6.37436	34.91383	0.000
Valid N (list wise)	30				
D – Duration of motor block	30	489.1667	13.29195	72.80303	

Table - 10: Comparison of duration for rescue analgesia in group C (clonidine with bupivacaine) with group D (dexmedetomidine with bupivacaine).

GROUP	N	Mean		Std. Deviation	‘P’ value
	Statistic	Statistic	Std. Error	Statistic	
C – Duration of rescue	30	263.1000	7.40058	40.53466	0.00
Valid N (list wise)	30				
D – Duration of rescue	30	455.9667	13.02628	71.34785	
Valid N (list wise)	30				

Table - 8 compares the duration of sensory blockade in group C (clonidine with bupivacaine) compared with group D (dexmedetomidine with bupivacaine). **Table – 8** shows that the duration time of sensory blockade in group D was greater than that of group C. On statistical analysis, this difference was found to be significant.

Table - 9 compares the duration of the motor blockade in group C (clonidine with bupivacaine) compared with group D (dexmedetomidine with bupivacaine). **Table – 9**

shows that the duration time of motor blockade in group D was greater than that of group C. On statistical analysis, this difference was found to be significant.

Table - 10 compares the duration for rescue analgesia in group C (clonidine with bupivacaine) compared with group D (dexmedetomidine with bupivacaine). **Table - 10** shows that the duration for rescue analgesia in group D was greater than that of group C. On statistical analysis, this difference was found to be significant. Sedation score as compared

between group C (clonidine with bupivacaine) compared with group D (dexmedetomidine with bupivacaine). Mean sedation score in Group C was 1. Mean sedation score in Group D was 2. This difference was statistically significant (P-value < 0.005).

Discussion

The demonstration of α_2 receptors in the peripheral nervous system prompted recent trials on the usage of α_2 receptor agonists, like clonidine and dexmedetomidine combined with bupivacaine for brachial plexus block for upper limb surgeries. Several studies have shown that the addition of these adjuvants produces a longer duration of post-operative analgesia. The mean age (in years) of the patients in group C (clonidine with bupivacaine) was 33.33 ± 14.55 . The mean age of patients in group D (dexmedetomidine with bupivacaine) was 29.13 ± 12.59 . The mean age of both groups was comparable. Male to female in group C was 53/47 and in the group D was 60/40, which were comparable [8]. Duration of surgery in group C was 92.50 ± 12.78 and in the group D was 95.16 ± 11.48 both were demographically comparable. The onset of sensory block in group C was 2.86 ± 0.77 minutes. The onset of sensory block in group D was 2.53 ± 1.0 minutes. The onset of sensory block in group D is faster than group C but this difference was not statistically significant. The onset of motor block in group C was 5.66 ± 1.39 minutes [9]. The onset of motor block in group D was 5.66 ± 1.48 minutes. The onset of motor block in group D is faster than group C; this difference was statistically significant 'p value < 0.005. The duration of sensory blockade in group C was 224.50 ± 32.70 minutes. Duration of sensory blockade in group D was 414.63 ± 70.35 minutes. Duration of sensory blockade in group D was statistically significant when compared to group C. Duration of the motor blockade in group D was 489.16 ± 72.80 minutes. Duration of the motor blockade in group D was statistically significant when compared to group C [10]. In this study, there was no significant change in the

hemodynamic baseline in both groups. None of the patients in the two groups showed any side effects like bradycardia, hypotension, shivering, dry mouth, arrhythmias, and local anesthetic toxicity. none of the patients reported clonidine or dexmedetomidine-related side effects when added to bupivacaine in supraclavicular brachial plexus blocks for upper limb surgeries [11]. In another study by Saxena H, et al. in 2014 [12], no significant side effects like hemodynamic instability and shivering were observed when clonidine or dexmedetomidine was added to bupivacaine in supraclavicular brachial plexus block for upper limb surgeries of moderate duration [12]. Similarly, Grande RP, et al. added dexmedetomidine as an adjuvant to bupivacaine in supraclavicular brachial plexus blocks for upper limb surgeries. No side effects were observed in both these studies. The mean sedation score in group C (clonidine with bupivacaine) was 1.0. The mean sedation score in group D (dexmedetomidine with bupivacaine). This difference in sedation score was statistically significant (p value < 0.005) [13]. Sedation is desired in the immediate post-operative period. In this regard, dexmedetomidine produces better sedation than clonidine when added to bupivacaine in supraclavicular brachial plexus blocks for upper limb surgeries of moderate duration (60 to 90 minutes). Duration of rescue analgesia as recorded when the patient complains of pain in the postoperative period for the first time; plotted in group D (dexmedetomidine with bupivacaine) was 455.96 ± 71.34 minutes versus group C (clonidine with bupivacaine) was 263.1 ± 40 minutes [14, 15].

Conclusion

We conclude that the addition of 1 $\mu\text{g}/\text{kg}$ of dexmedetomidine to 0.25% bupivacaine accelerates the onset of sensory and motor block, prolongs the duration of sensory and motor block and the time for rescue analgesia with mild sedation without any adverse effects when compared to clonidine as an adjuvant to bupivacaine in supraclavicular brachial plexus blocks for upper limb surgeries.

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