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Original Research Article.

A Prospective, Randomized Study Comparing Efficacy of Clonidine Versus Dexmedetomidine as An Adjuvant to Bupivacaine in Supraclavicular Brachial Plexus Block for Both Bone Forearm Upper Limb Surgeries

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ABSTRACT

Background: The use of ultrasound-guided supraclavicular block is a prevalent method for managing pain during upper limb surgical procedures. The objective of this study is to evaluate and compare the analgesic efficacy of clonidine and dexmedetomidine as adjuvants to bupivacaine in supraclavicular brachial plexus block for bone forearm surgeries.

Materials and Methods: A total of 60 patients, categorized into ASA grading I and II, were randomly allocated into Group C and Group D of 30 each. Group C received a combination of 38 ml of 0.25% bupivacaine and 100 mcg of clonidine, while Group D received the same combination but with an additional 100 mcg of dexmedetomidine.

Results: The study revealed no significant differences in age, sex or weight distribution between the two groups. The mean time to onset of sensory block was significantly shorter in the Group D (3.63 vs 5.37 mins) and the mean time to onset of motor block was also significantly shorter (5.23 vs 6.43 mins) compared to Group C. Additionally, the mean duration of sensory block, motor block and analgesia was significantly longer in the Group D (520 vs 426 mins, 503.37 vs 412.0 mins, and 702.9 vs 601.4 mins, respectively; p<0.01).

Conclusion: Use of Dexmedetomidine as an adjuvant to bupivacaine in brachial plexus block was found to be superior to clonidine, with stable hemodynamics and minimal adverse effects.

Keywords: Supraclavicular Brachial Plexus, Ultrasound, Dexmedetomidine, Clonidine.

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INTRODUCTION

Surgeries on the upper limbs are typically carried out using peripheral blocks, like brachial plexus block. These peripheral nerve blocks not only provide anesthetic effect during the operation but also continue to offer analgesia after the surgery without causing any major side effects.[1]

Dexmedetomidine, a potent drug that blocks the α2 adrenoceptor, was investigated as a way to extend the duration of analgesia and reduce side effects when added to regional nerve blocks. This drug has been particularly interested in their analgesic, sedative, cardiovascular stabilizing and perioperative sympatholytic effects. Various modes of administration of this including epidural injection, direct infusion into the spinal fluid and perineural injection, have been evaluated in isolation or in combination with other medications to enhance the efficacy and duration of pain relief.[2-4] Dexmedetomidine, a powerful medication demonstrates approximately an eightfold greater specificity compared to clonidine.[5] Previous studies have indicated that intravenous administration of dexmedetomidine results in a significant reduction in opioid usage and a decrease in the amount of anesthesia required.[6] In human trials, adding dexmedetomidine to local anesthesia in different regional blocks extended the period of analgesia post operatively.[7-10]

Clonidine, another substance that targets the α2 adrenoceptor, has been shown to improve the effectiveness of nerve blocks by making them start sooner, work better during the operation, and last longer after the surgery. The efficacy of clonidine is dose-dependent and believed that it may augment the inhibitory effect of local anesthetics by promoting the opening of potassium channels causing hyperpolarization which makes cell unresponsive to excitatory stimuli.[11] Several research endeavors

have been conducted to evaluate the duration of nerve block and pain relief provided by dexmedetomidine in comparison to clonidine.

The objective of this study was to investigate the hypothesis that the incorporation of dexmedetomidine as local adjuvant to supraclavicular brachial plexus block in both bone forearm upper limb surgeries would extend the duration of both sensory and motor block, as well as the duration of pain relief post-surgery, in comparison to clonidine.

MATERIALS AND METHODS

Study Design

Prospective double blinded randomized controlled study.

Study Site

The current study was conducted during Sep 2020 and May 2021 in the Department of Anesthesia, Yashoda multi-specialty hospital, Secunderabad, accredited by NABH and NABL.

Study Population

ASA Grade I and II in patients aged 21-65 yrs, posted for both bone forearm upper limb surgeries.

Study Sample

This research encompassed a total of 60 individuals randomly divided into 2 groups including 30 patients each. Group C (Bupivacaine + clonidine) received 38 ml of 0.25 % bupivacaine and 100 mcg of clonidine and Group D (Bupivacaine + dexmedetomidine) received 38 ml of 0.25 % bupivacaine and 100 mcg clonidine.

Inclusion Criteria

Participants aged between 21 and 65 years, either gender, scheduled for bone forearm surgery, specifically with an American Society of Anesthesiologists (ASA) physical status I or II, with a Body Mass Index (BMI) ranging from 18 to 35 kg/m2 are eligible for inclusion

Exclusion Criteria

Patients who are unable to provide consent, with a history of chronic use of strong opioids (such as morphine or oxycodone), with allergies to local anesthetics or any medications, with contraindications to regional anesthesia, such as coagulopathy were excluded. Furthermore, individuals with pre-existing neurological deficits in the upper limb or phrenic nerve palsy, with chronic lung diseases, including COPD and uncontrolled asthma, with uncontrolled anxiety, significant cardiovascular disease, uncontrolled diabetes, schizophrenia or bipolar disorder, peripheral neuropathy, renal impairment (creatinine > 2.0 mg/dl), liver impairment, a BMI greater than 35, a history of chronic pain conditions or daily use of analgesics or steroids, a history of drug or alcohol abuse, pregnancy or those currently using gabapentin, pregabalin, tricyclic antidepressants, serotonin-norepinephrine reuptake inhibitors, tramadol, were excluded for this study.

The patients were maintained on nil per os (nothing by mouth) for solid foods for six hours and clear fluids for two hours prior to surgery. Intravenous access was established, beginning with the insertion of a 20 G, intravenous cannula on the contralateral upper limb under aseptic precautions. Before the initiation of the procedure, a 2mg intravenous dose of midazolam was administered. The patient was positioned in a supine position, with the head tilted away from the side to be blocked. The scanning procedure utilized a high-frequency ultrasound probe (Ultrasound probe LOGIQ V5/V3 MHz probe, General Electric Medical Systems, Wisconsin, USA). The probe was placed in the supraclavicular fossa, positioned superior to the clavicle, and slightly angled toward the thorax. The subclavian artery was easily identifiable. The brachial plexus was visualized as multiple hypoechoic disks, superficial and lateral to the subclavian artery. The needle was inserted lateral to the transducer, moving in a direction parallel to the ultrasound beam. The needle was progressively directed medially towards the subclavian artery, ensuring that the tip was in close proximity to the brachial plexus, lateral and superficial to the artery.

After a careful aspiration Group C and Group D patients received respective dosage of drugs. The block was performed using 20G, 100 mm short bevel needle (Jelco needle). Following the completion of the procedure, a sterile dressing was applied over the insertion site.

Demographic data were recorded in both study groups like age, sex, anthropometric parameters. Study parameters like time of onset and duration of both sensory and motor block, duration of analgesia and number of rescue analgesia in 24 hrs were recorded in both the groups.

Statistical Analysis

The data was meticulously recorded in a pre-established study protocol. Qualitative data was depicted through frequency and percentage representations. All quantitative data was presented in the form of means and standard deviations and subsequently compared utilizing the student's t-test. On the other hand, qualitative data was represented as frequencies and percentages and was analyzed employing the Chi-square test. A $p < 0.05$ was considered significant.

Table 1: Age, gender, weight, and height comparison among study groups

Characteristics	Group		Total	P-value
	Bupivacaine + clonidine (C)	Bupivacaine + Dexmedetomidine (D)		
Age (Mean±SD)	30 (39.30±12.9)	30 (35.27±9.18)	60	0.186
Female	14(46.7%)	14(46.7%)	37(41.1%)	1.0
Male	16(53.3%)	16(53.3%)	53(58.9%)	
Weight	66.50±6.44	67.07±5.98	60(100%)	0.319
Height	167.03±3.62	166.57±3.61	60(100%)	0.47

Table 2: Mean comparison of BMI, Duration of surgery, Sensory Block and Motor Block Characteristics

Parameters	Group	N	Mean±SD	*P*-value
Onset of Sensory Block	**C**	30	5.37±0.55	<0.01
	D	30	3.63±0.56	
Complete block (Sensory)	**C**	30	22.70±0.79	<0.01
	D	30	19.60±1.22	
Duration of Sensory Block (min)	**C**	30	426.60±17.40	<0.01
	D	30	520.43±16.31	
Onset of Motor Block	**C**	30	6.43±0.73	<0.01
	D	30	5.23±0.77	
Complete block (Motor)	**C**	30	25.77±1.01	<0.01
	D	30	23.03±4.12	
Duration of Motor Block (min)	**C**	30	412.00±17.15	<0.01
	D	30	503.37±16.87	
Time for first rescue Analgesia (mins)	**C**	30	601.43±23.50	<0.01
	D	30	702.90±28.69	

Table 3: Comparison of changes in Heart rate among study groups

		Mean Heart rate		
Time	**N**	**Bupivacaine + clonidine (C) Mean±SD**	**Bupivacaine + Dexmedetomidine (D) Mean±SD**	***P***
Base line	30	83.43±6.27	82.20±7.46	0.183
5 mins	30	82.70±6.41	81.53±7.21	0.384
10 mins	30	81.93±6.81	81.40±7.18	0.658
15 mins	30	81.20±6.44	79.37±6.33	0.425
20 mins	30	80.13±6.02	79.53±5.76	0.675
25 mins	30	80.17±6.25	79.20±5.44	0.587
30 mins	30	81.83±6.98	78.97±6.04	0.239
45 mins	30	81.30±7.41	78.20±5.54	0.219
60 mins	30	80.30±6.89	78.30±5.21	0.359
90 mins	30	79.67±6.55	77.87±5.46	0.498
120 mins	30	78.97±6.22	78.13±5.14	0.852
150 mins	30	78.30±6.84	78.83±6.01	0.891
180 mins	30	78.47±6.93	79.10±5.81	0.852
210 mins	30	78.83±6.82	79.47±5.60	0.927
240 mins	30	78.37±6.32	79.23±5.91	0.857
270 mins	30	77.87±6.37	79.87±6.94	0.643
300 mins	30	77.73±5.85	79.83±6.95	0.232
360 mins	30	79.33±6.29	80.63±6.40	0.748
420 mins	30	80.63±6.40	81.17±6.44	0.714
480 mins	30	81.17±7.53	80.50±6.17	0.897
540 mins	30	80.53±7.06	81.30±6.78	0.767
600 mins	30	80.80±7.52	82.33±6.24	0.467
660 mins	30	81.80±7.85	83.00±5.87	0.686
720 mins	30	81.17±6.43	81.83±6.13	0.42

Table 4: Comparison of changes in Systolic blood pressure and Diastolic blood pressure among study groups

	Systolic blood pressure		P-value	Diastolic blood pressure		P-value
	Bupivacaine + clonidine (C) Mean±SD	Bupivacaine + Dexmedetomidine (D) Mean±SD		Bupivacaine + clonidine (C) Mean±SD	Bupivacaine + Dexmedetomidine (D) Mean±SD	
Base line	123.73±8.31	120.63±7.45	0.317	74.50±7.38	71.70±4.26	0.195
5 mins	124.13±8.59	120.43±7.64	0.226	74.87±7.16	71.50±4.87	0.104
10 mins	124.13±8.19	120.90±7.62	0.314	73.57±7.40	71.30±4.76	0.279
15 mins	124.63±8.98	120.33±7.32	0.13	74.40±6.66	71.57±5.26	0.177
20 mins	124.33±9.14	120.97±5.69	0.151	73.87±6.02	71.53±4.98	0.221
25 mins	123.27±9.33	121.67±6.87	0.713	73.63±5.46	72.33±4.20	0.547
30 mins	124.03±8.56	122.23±8.03	0.574	72.90±4.49	71.30±3.83	0.409
45 mins	124.40±7.68	122.33±7.51	0.6	73.80±4.96	71.20±3.50	0.113
60 mins	124.47±8.45	121.50±6.87	0.225	73.90±5.35	71.27±3.84	0.155
90 mins	124.23±7.65	120.50±5.96	0.065	74.47±6.66	72.23±4.47	0.229
120 mins	124.27±8.55	120.37±6.85	0.117	73.63±6.08	72.27±3.41	0.594
150 mins	123.13±8.33	120.90±6.22	0.436	74.43±6.45	72.40±3.97	0.181
180 mins	123.00±7.81	120.70±7.71	0.503	73.47±5.62	71.40±4.80	0.365
210 mins	123.07±7.25	119.03±7.05	0.067	74.77±6.72	71.07±4.95	0.064
240 mins	123.77±7.87	119.83±6.95	0.05	74.43±6.88	71.40±3.01	0.085
270 mins	123.47±7.51	120.97±7.25	0.39	75.27±7.47	72.70±3.78	0.237
300 mins	122.37±7.70	120.97±7.15	0.541	74.93±7.10	72.00±4.68	0.051
360 mins	121.47±7.65	120.97±7.25	0.691	75.40±7.67	71.17±4.67	0.06
420 mins	121.93±7.84	120.27±6.93	0.535	74.13±6.32	72.07±4.86	0.233
480 mins	122.23±6.73	120.93±5.98	0.307	75.30±4.89	71.80±4.32	0.051
540 mins	123.53±8.14	120.13±6.64	0.169	73.57±5.18	71.90±4.30	0.437
600 mins	123.90±7.07	120.07±7.64	0.102	73.77±5.69	71.97±4.86	0.35
660 mins	123.63±8.12	120.27±7.05	0.219	74.50±6.00	69.87±4.80	0.03
720 mins	123.63±7.37	119.87±4.88	0.09	74.00±5.45	71.50±4.94	0.108

Table 5: Mean comparison of study groups as per Pain Score

NRS	GROUP	N	MEAN±SD	P-VALUE
0 hrs	**C**	30	0.00±0.00	NA
	D	30	0.00±0.00	
4 hrs	**C**	30	1.19±1.12	0.62
	D	30	1.83±0.84	
8 hrss	**C**	30	2.80±1.10	<0.01
	D	30	3.97±0.99	
12hrs	**C**	30	4.77±1.30	<0.01
	D	30	6.21±1.70	
24 hrs	**C**	30	5.98±1.30	<0.01
	D	30	7.73±1.20	

RESULTS

Table 1 revealed that the mean average age among the participants in the study was 58.35±7.25 years, and there was no notable disparity between the two groups (p = 0.186). Among the 60 participants, 53.3% were male while 46.7% being female, with no significant difference between the two groups (p=1.0). Both the groups were comparable with respect to age and anthropometric parameters i.e. weight and height (p>0.5). Table 2 explained that the mean time from onset to completion of the motor block was

significantly shorter in the Dexmed group (Group D) (5.23 vs 6.43 mins; p<0.01) and the completion time was also significantly reduced (23.03 vs 25.77 mins; p<0.01) compared to the clonidine group (Group C). Furthermore, the overall duration of the motor block was found to be significantly greater in Group D (503.37 vs 412.0 mins; p<0.01). Additionally, the time required for the first administration of rescue analgesia was significantly greater Group D (702.9 vs 601.4 mins; p<0.01), and the requirement for rescue analgesics in the first 24 hours was significantly lower in the Group D (1.07 vs 1.79 mins; p<0.01).

Table 3 revealed that no difference was observed between study groups with regards to heart rate at baseline and also during the surgery (p>0.05).

Table 4 elucidated that between Group D and Group D, no discernible differences were revealed in systolic blood pressure at baseline or throughout the surgical procedure (p>0.05). Similarly, there was no significant disparity noted between the groups concerning diastolic blood pressure at baseline or during the surgical intervention (p>0.05).

Table 5 explained that pain intensity was quantified utilizing a numerical rating scale ranging from 1 to 10. There was no discernible difference between the two groups in terms of pain levels until four hours post-surgery. However, it was observed that the pain scores in Group D were notably reduced in comparison to those in the Group C starting from the 8th hour onwards, extending up to the 25th hour. This reduction in pain intensity was statistically significant (p < 0.01).

DISCUSSION

The supraclavicular block is a regional anesthetic technique utilized either as an alternative or in conjunction with general anesthesia or as a method for managing postoperative pain following upper extremity surgical procedures.[12] The quest for the most effective additive continues, leading to the exploration of novel α2 adrenergic agents such as dexmedetomidine and selective α-2 adrenergic agonists like clonidine. Dexmedetomidine, a highly potent non-opioid drug characterized by greater selectivity and potency compared to clonidine, also has a limited duration of action.[13] Furthermore, dexmedetomidine demonstrates an enhanced cardiovascular safety profile in comparison to other medications.[14]

Clonidine was initially employed for its antihypertensive properties. Nonetheless, the particular side effects of clonidine seem to be less noticeable because there are no α2 adrenoceptors present on the nerve fibers of normal peripheral nerves.[15] Both dexmedetomidine and clonidine are recognized as α2 selective agonists and exert similar mechanisms of action. The majority of studies conducted to substantiate the peripheral effects of α2 agonists have been conducted on animal models. Considering these observations, we have chosen to compare the efficacy of two α2 agonists, in peripheral nerve blocks.

In our study, both groups were found to be comparable with respect to age, gender and anthropometric parameters, including weight and height. Our study indicates that the onset of sensory and motor blockade occurred at a more rapid pace in Group D as compared to Group C, along duration, sensory motor block is effective and the duration of pain relief lasts was extended in group D compared to group C.

In this study, we found that the mean onset time for sensory block and motor block were significantly faster in Group D compared to Group C. The findings of our study correlate with study of More et al., where Dexmedetomidine group (9.17±1.26 min) has shown faster onset of sensory and motor block when compared to Clonidine group (11.07±2.14).[16] Another study by KG Rao group[17] compared the efficacy of Dexmedetomidine and clonidine when 1 mcg/kg each (2ml) added to 38 ml 0f 0.25 % bupivacaine respectively showed faster onset of sensory and motor block. Additionally, the study by Nazir et al. with 75 patients aged between 20 and 60 years scheduled for upper limb surgery received a combination of 0.5% ropivacaine and dexmedetomidine experienced a longer duration of sensory and motor block compared.[18] Group D in our study had a significantly longer mean time for first rescue analgesia than Group C, which is consistent with the Swamy et al. Study.[19] The duration of post-operative analgesia was significantly longer in a Group who received dexmedetomidine as an adjuvant as compared to Clonidine group (p-value<0.05).[20-21] Subsequently, in a meta-analysis study it was observed that time before the need for analgesic requirements was significantly extended by 38.6 minutes, when dexmedetomidine was used as an adjuvant to local anesthetics (bupivacaine or ropivacaine).[22] The current results, which show no significant differences between the study groups in terms of heart rate, systolic blood pressure (SBP) and diastolic blood pressure (DBP) at baseline and during the procedure (p>0.05), are consistent with the study of Saurabh and Nanda.[23]

CONCLUSION

Dexmedetomidine when added to Bupivacaine in supraclavicular brachial plexus block enhanced the duration of sensory and motor block and also the duration of analgesia as compared with clonidine thus shows an edge over clonidine when used as adjuvant to bupivacaine for brachial plexus block.

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