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Research Article

Comparison of clonidine and dexmedetomidine as an adjuvant to bupivacaine in supraclavicular brachial plexus block for upper limb orthopedic procedures

Rajaclimax Kirubahar, Bose Sundari, Vijay Kanna*, Kanakasabai Murugadoss

Department of Anesthesiology, Chennai Medical College Hospital & Research Centre, Trichy, Tamilnadu, India

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***Correspondence:**
Dr. Vijay Kanna,
E-mail: drvijaykanna@gmail.com

ABSTRACT

Background: Supraclavicular brachial plexus block is used commonly for upper limb orthopedic procedures. Among the adjuvants used to improve the quality of block induced by bupivacaine the alpha 2 agonists are of new interest. This study was done to compare dexmedetomidine and clonidine as adjuvants to bupivacaine for supraclavicular brachial plexus block in upper limb orthopedic surgeries.
Methods: 60 ASA I/II patients aged between 20 and 50 years undergoing upper limb orthopedic procedures were selected and divided into two groups of 30 each. Group C received 35 ml of 0.375% Bupivacaine and clonidine 2µg/kg while Group D received 35 ml of 0.375% bupivacaine and dexmedetomidine 2 µg/kg. Onset time to sensory and motor blockade, vitals, complete duration of motor and sensory block, total duration of analgesia and side effects were noted.
Results: The mean time of onset for sensory block and motor block in Group D was lower when compared to Group C. Except at 5th minute the pulse rate and mean arterial pressure were lower in Group D when compared to Group C. The mean time for total duration of sensory block and motor block was more in Group D when compared to Group C. The total duration of analgesia was higher in Group D than in Group C.
Conclusions: The addition of dexmedetomidine to bupivacaine during supraclavicular brachial plexus block produces a shorter onset of time to sensory and motor block with prolonged duration of analgesia when compared to clonidine added to bupivacaine.

Keywords: Dexmedetomidine, Clonidine, Supraclavicular brachial plexus block

INTRODUCTION

The surgeries in the upper limb can be done by general or regional anesthesia or both. Nowadays regional anesthesia has wide application in providing surgical anesthesia, complete muscle relaxation, better hemodynamic stability and post-operative analgesia as well as in treating chronic pain syndromes. The sympathetic block produced by regional anesthesia reduces vasospasm.[1] Regional anaesthesia has several advantages in the postoperative period compared with general anaesthesia, including decreased sedation, decreased nausea and vomiting, early discharge from the recovery room and a smooth transition to pain control as the block effects gradually dissipate. Various adjuvants like morphine, fentanyl, sufentanil, dexamethasone, midazolam, ketamine, neostigmine, sodium bicarbonate are added to local anesthetic agents during regional anesthesia.[2] Alpha 2 receptor agonists clonidine and dexmedetomidine are of new interest in regional anesthesia because of their better haemodynamic stability, sedation and longer duration of postoperative

analgesia. Dexmedetomidine is a highly selective alpha 2 adrenergic receptor agonist than clonidine.[3] Dexmedetomidine improves the quality of anesthesia by means of fast onset, prolonged duration with sedative effect. It provides excellent post-operative analgesia, when compared to other adjuvants. The purpose of this study was to compare the efficacy of dexmedetomidine and clonidine with bupivacine in brachial plexus block by supraclavicular approach.

METHODS

This study was conducted over a period of 6 months from December 2014 after obtaining approval from the ethical clearance committee of the college and written informed consent by the patients. 60 ASA I/II patients aged between 20 and 50 years undergoing upper limb orthopedic procedures were selected for Supraclavicular brachial plexus block and divided into two groups of 30 each. Exclusion criteria were patient refusal, patients on adrenoreceptor agonist or antagonist therapy, suspected coagulopathy, infection at the site of block, history of respiratory, cardiac, hepatic or renal failure, patients with medical complications like severe anemia, severe hypovolemia, shock, septicemia, allergy to local anaesthetics and study drug and pregnant women. In this prospective randomised control study, patients were divided into two groups viz, clonidine group – Group C: received 35 ml of 0.375% bupivacaine and 2µg/kg clonidine, dexmedetomidine group – Group D: received 35 ml of 0.375% bupivacaine and 2 µg/kg dexmedetomidine. Under strict aseptic precautions, supraclavicular brachial plexus block was performed using 22G 5cm needle. All patients were monitored for anesthesia and analgesia upto 16 hours postoperatively.

Sensory block was assessed by sensations to pinprick on skin dermatomes C4toT2 while motor blockade was assessed by movements in thumb, adduction for ulnar nerve, abduction for radial nerve, opposition for median nerve, flexion of elbow, the supination and the pronation of forearm for musculocutaneous nerve were assessed. Hollmen scale made use of to examine sensory block.[4] Score [1] = Normal sensation of pinprick; [2] = Weaker sensation of pin prick felt as compared with other upper limb; [3] = Pin prick recognized as touch with blunt object; [4] = No perception of pin prick. Modified bromage scale (MBS) was used to examine motor block.[5] Score [4] = full strength in relevant muscle groups; [3] = strength reduction but able to move against resistance; [2] = ability to move against gravity but not against resistance; [1] = discrete movements (trembling) of muscle groups; [0] = absence of movements. Examination was conducted every one minute after giving the drug and the time taken for initiation of the motor and sensory block was noted. The sensory block onset time was calculated as the time period between the end of administration of the local anaesthetic solution to loss of touch sensation (Hollmen score 2) on all nerve territories. The duration of sensory block is calculated as the time period between the ends of local anaesthetic injection to complete resolution of anaesthesia on all four nerves. The motor block onset time was calculated as the time period between the end of the local anaesthetic injection to MBS score 2. The duration of motor block was calculated as the time period between the end of local anaesthetic administration and the complete recovery of the motor function of the hand and forearm. Time for complete block is defined as motor block amount to MBS score 0. Total duration of sensory block is defined as the time from giving the drug and the time when patient complained pain in the period post-surgery. When general anesthesia was needed for unsuccessful block or inadequate block that was excluded from the study. Intraoperative and post-operative vitals were recorded and complications if any were noted.

Statistical tests used

One way ANOVA, student's t test, Pearson correlation for datas and Chi square test for consolidated figures. P value: <0.05 taken as significant.

RESULTS

Sixty ASA I and II of either sex between 15-50 years, posted for upper limb surgeries under brachial plexus block by Supraclavicular approach were selected for the study. The study was to compare the efficacy of dexmedetomidine and Clonidine with 0.375% bupivacaine for brachial plexus block by supraclavicular approach.

Table 1: Age distribution between the two groups (in years).

	Mean	SD	P value
Group C	34.00	7.469	0.149
Group D	37.167	9.229	

Table 2: Comparison of sex distribution between both the groups.

	Male	Female	Total
Group C	17	13	30
Group D	16	14	30
Total	33	27	60

Table 3: Comparison of patients weight between both the groups (in kg).

	Mean	SD	P value
Group C	59.533	5.981	0.301
Group D	61.2	6.386	

In both the groups' adverse effects such as nausea, vomiting, hypoxemia and hypotension were not observed. Age, weight of the patient and duration of surgery

between both the groups were comparable and were statistically not significant. (p>0.05) (Tables 1 - 4).

Table 4: Comparison of duration of surgery (minutes) between the groups.

	Mean	SD	P value
Group C	100.167	10.462	0.752
Group D	99.333	9.890	

The pre-operative hemodynamic variables among the two groups were comparable but statistically not significant. (p>0.05) Except at 5th minute, the intraoperative pulse rate values were lower in Group D, when compared to Group C. This was statistically significant. (p<0.05) Except at the 5th minute, the intraoperative MAP values were lower in Group D, when compared to Group **C**. This was statistically significant (p<0.05) Post-operative PR values in Group D was lower than Group C in the first postoperative hour (p<0.05). In the 2H, 4H, 8H, 12H, 16H, the values were statistically not significant (Tables 5 – 9).

Table 5: Comparison of baseline hemodynamic variables between the groups.

	Group C		Group D		
	Mean	SD	Mean	SD	P value
PR (per minute)	83.4	5.43	83.267	5.388	0.924
MAP (mmHg)	93.5	6.474	92.900	6.375	0.719

Table 6: Comparison of pulse rate between both the groups at various time intervals (per minute).

	Group C		Group D		P
	Mean	SD	Mean	SD	value
5 min	83.900	5.189	83.433	5.380	0.734
10 min	85.233	5.380	74.933	4.226	0.001
15 min	86.667	6.013	73.900	4.221	0.001
20 min	87.600	5.922	71.667	5.707	0.001
30 min	89.167	5.427	71.333	3.898	0.001
45 min	88.800	5.774	70.167	2.902	0.001
60 min	87.900	6.525	68.867	2.636	0.001
90 min	88.500	5.551	71.367	2.619	0.001
EOS	87.667	5.492	72.633	5.707	0.001

The mean time for onset of sensory block in Group D was 4.7 minutes which was lower than Group C -8.47 minutes. This was statistically significant (p<0.001) The mean time for onset of motor block in Group D was 9.63 minutes which was lower than Group C-13.1minutes.This was statistically significant (p<0.05) The mean time for total duration of sensory block in Group D was 537.8 minutes. This was higher than in Group C-319.1minutes. It was statistically significant (p<0.05) the mean time for total duration of motor block in Group D was 466.87 minutes. This was higher than in Group C 222.23 minutes. It was statistically significant (p<0.05) the total duration of analgesia in Group D was 666.27 minutes. This was higher than in Group C – 375.23 minutes. It was statistically significant. (p<0.05) (Tables 10 - 14).

Table 7: Comparison of MAP between the groups at various time intervals (mm of Hg).

	Group C		Group D		P
	Mean	SD	Mean	SD	value
5 min	93.700	6.439	92.900	6.375	0.631
10 min	93.400	6.317	87.533	6.163	0.001
15 min	93.433	6.479	86.633	6.184	0.001
20 min	93.500	6.307	85.800	6.348	0.001
30 min	93.200	6.239	84.100	6.272	0.001
45 min	93.067	6.777	83.367	6.483	0.001
60 min	92.900	6.546	82.867	6.501	0.001
90 min	93.167	6.691	83.733	6.475	0.001
EOS	93.067	6.464	84.700	6.109	0.001

Table 8: Comparison of postoperative pulse rate between the two groups (per minute).

	Group C		Group D		P
	Mean	SD	Mean	SD	value
1 Hour	88.167	5.547	77.00	2.779	0.001
2 Hour	88.567	5.354	85.50	4.592	0.021
4 Hour	88.467	5.469	88.633	5.223	0.904
8 Hour	87.900	5.435	88.967	5.461	0.451
12 Hour	87.433	6.146	88.100	5.561	0.661
16 Hour	86.533	6.410	88.067	5.942	0.341

Table 9: Comparison of postoperative MAP between the groups (mm of Hg).

	Group C		Group D		P
	Mean	SD	Mean	SD	value
1 Hour	93.033	6.300	85.900	5.979	0.001
2 Hour	93.200	6.272	90.600	6.095	0.109
4 Hour	93.100	6.418	90.500	5.979	0.156
8 Hour	92.533	6.198	91.267	6.231	0.433
12 Hour	92.767	6.044	91.267	6.231	0.347
16 Hour	92.833	6.035	91.500	6.191	0.402

Table 10: Comparison of onset time of sensory block (minutes).

	Mean	SD	P value
Group C	8.47	1.04	<0.001
Group D	4.7	0.59	

Table 11: Comparison of onset time of motor block (minutes).

	Mean	SD	P value
Group C	13.1	1.42	<0.001
Group D	9.63	0.89	

Table 12: Comparison of total duration of sensory block between both groups (minutes).

	Mean	SD	P value
Group C	319.1	32.74	<0.001
Group D	537.8	32.67	

Table 13: Comparison of total duration of motor block between both groups (minutes).

	Mean	SD	P value
Group C	319.1	32.74	<0.001
Group D	537.8	32.67	

Table 14: Comparison of total duration of analgesia between both groups (minutes).

	Mean	SD	P value
Group C	375.23	32.6	<0.001
Group D	666.27	36.54	

DISCUSSION

Brachial plexus block provides post-operative analgesia of short duration even when a long acting local anaesthetic like bupivacaine is used alone. Various adjuvants like opioids, midazolam, neostigmine, vasoconstrictors, sodium bicarbonate, dexamethasone have been used as an adjuvant with local anesthetics to prolong the time of analgesia, but they may have unwanted side effects or may be ineffective. The alpha 2 agonists dexmeditomidine and clonidine are known to have analgesic effect and also enhance the effect of local anaesthetics intrathecally and epidurally. Alpha2 agonists produce this effect by its action on alpha 2 adrenergic receptors found in peripheral nerves.

Here an attempt has been made to compare the efficacy of dexmeditomidine and clonidine as an adjuvant to bupivacaine 0.375% in brachial plexus block (supraclavicular approach) in terms of onset time, duration of analgesia and sedation. Hemodynamic variables and rescue analgesic requirements in first 24 hours were also studied.

The α2 agonists dose dependently enhance local anaesthetic potency and prolong its duration by combining at the α2 receptors at the peripheral level. The other possible mechanisms by which the α2 agonists improve local anaesthetic action include vasoconstriction around the site of injection, thus the absorption of local anaesthetic drug will be delayed, resulting in a prolongation of the local anaesthetic effect. Other mechanisms include release of local enkephalin like substances, decrease in the release of local inflammatory mediators and increase in the release of anti-inflammatory cytokines.

Clonidine and dexmedetomidine are the currently used α2 receptor agonists. The usages of clonidine in brachial plexus block with various local anaesthetics yield conflicting results. Dexmedetomidine has been found to be an effective and safe adjuvant in many studies on neuraxial and peripheral nerve blocks.

Swami SS, et al studied the efficacy of dexmedetomidine and clonidine with bupivacaine in brachial plexus block by supraclavicular approach.[6] They found that dexmedetomidine increases the duration of motor and sensory block with better quality and better post-operative analgesia when compared to clonidine. Rachana G, et al studied about dexmedetomidine with bupivacaine in brachial plexus block by supraclavicular approach.[7] They concluded that dexmedetomidine provided longer duration of motor and sensory block, increased duration of post-operative analgesia and better hemodynamic stability when added with bupivacaine. Sandhya agarwal, et al studied dexmedetomidine with bupivacaine in brachial plexus block by supraclavicular approach.[8] They concluded that dexmedetomidine hastens the onset time, increases the sensory and motor block duration and post-operative analgesia. Ammar AS et al studied the effects of dexmedetomidine with bupivacaine in brachial plexus block by infraclavicular approach.[9] The result was dexmedetomidine enhances the sensory and motor block onset time, increases the duration of analgesia, increases the sensory and motor blockade duration, produce less VRS (verbal response scale) pain scores and reduces supplemental opioid requirements when added with bupivacaine. Kaygusuz K et al studied the efficacy of adding dexmedetomidine (1µg/kg) to levobupivacaine (0.5%) in axillary block.[10] They concluded that dexmedetomidine shortens the onset time for sensory block, increases the duration of motor and sensory block and extends the post-operative analgesia. Feroz Ahmad Dar, et al done a study about dexmedetomidine added to ropivacaine in brachial plexus block by axillary approach.[11] They concluded that dexmedetomidine shortens the sensory and motor blockade onset time. It also prolongs the duration of sensory and motor blockade and increases the duration of analgesia. Solanki S, et al compared the effects of dexmedetomidine or clonidine with bupivacaine in trauma patients posted for lower limb surgeries.[12] They observed that dexmedetomidine (5µg) added to bupivacaine (15mg) intrathecally provides longer duration of postoperative analgesia than clonidine (50 mcg).

CONCLUSION

In adult patients undergoing orthopaedic forearm and hand surgeries under Supraclavicular brachial plexus block, the addition of 2µg/kg of dexmedetomidine to 35 ml of bupivacaine (0.375%) produces a shorter onset time for sensory and motor blockade. It also prolongs the duration of sensory and motor blockade. Postoperatively the duration of analgesia is prolonged.

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