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A Comparative Study between Ropivacaine with Clonidine and Bupivacaine with Clonidine in Brachial Plexus Blocks in Upper Limb

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Abstract

Introduction: The supraclavicular brachial plexus block provides anaesthesia of entire upper extremity in most consistent manner. Brachial plexus blockade for upper limb surgeries is advantageous as the effect of drug is limited to the part of the body to be operated upon. *Materials and Methods:* The present study titled "A comparative study of Ropivacaine + Clonidine with Bupivacaine + Clonidine in supraclavicular brachial plexus block" was carried out at Kamineni Institute of Medical Sciences, Narketpally, Nalgonda District, Telangana State. It was a prospective and randomized study. Sixty patients of age group between 18 and *70 years* admitted between *August 2018* and *November 2018* were selected for the study. These patients were undergoing elective operative procedures for upper limb surgeries (i.e., elbow, forearm and hand surgeries). Exclusion criteria included patient's refusal, history of bleeding disorders or patients on anticoagulant therapy, peripheral neuropathy, local infection, respiratory disease, or known allergy to local anesthetic drugs. Each patient was visited pre-operatively and the procedure was explained and informed written consent was obtained. Investigations like Hemoglobin, Bleeding time, Clotting time, blood grouping, random blood sugar, blood urea, serum creatinine, bleeding time, clotting time, chest x-ray, ECG were done. *Results:* The present study was conducted on 60 consenting patients aged between 18 and 70 years. Group RC received *30 ml* of 0.5% Ropivacaine + clonidine (*30 mcg*). Group BC received 30 ml of 0.5% Bupivacaine + clonidine (*30 mcg*) for brachial plexus block by supraclavicular approach. The minimum age in both groups was *18 years*. The maximum age in both groups was *60 years* and *65 years* respectively. The mean age in group BC were 31.20 ± 12.59 and RC were 32.00 ± 13.17 respectively. There was no significant difference in the age of patients between the Group BC and Group RC. Both groups were similar with respect to age distribution ($p > 0.05$). *Conclusion:* From our study, we concluded that addition of Clonidine (*2 µg/kg*) to 0.5% Ropivacaine in supraclavicular brachial plexus block has advantages compare to bupivacaine with clonidine Faster onset of analgesia, sensory and motor blockade.

Keywords: Supraclavicular brachial plexus block; Ropivacaine; Clonidine.

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Introduction

The supraclavicular brachial plexus block provides anesthesia of entire upper extremity in most consistent manner. Brachial plexus blockade for upper limb surgeries is advantageous as the effect of drug is limited to the part of the body to be operated upon.[1]

A commonly used drug for this technique is bupivacaine 0.5% which is a well-established long acting local anesthetic, which like all amide anesthetics has been associated with cardiotoxicity

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when used in high concentration or when accidentally administered intravascularly.[2]

As with other fields, regional anesthesia too, has undergone major developments, both in techniques and drug availability. Ropivacaine was thus developed after it was noted that bupivacaine was associated with significant number of cardiac arrests. Ropivacaine is a new long acting local anesthetic drug belonging to the amino amide group. Ropivacaine and bupivacine belong to pipecoloxylidides group of local anesthetics. It is a pure S(-) enantiomer, unlike Bupivacaine, which is a racemate, developed for the purpose of reducing potential toxicity and improving relative sensory and motor block profiles.[3,4]

Addition of adjuvant drugs to the local anesthetic might improve quality, onset and duration of block and decrease post-operative analgesic requirement and systemic side effects.[2] Opioids, clonidine, ketamine and prostigmine have been added to local anesthetics and injected extradurally, intrathecally or in nerve plexuses for a more intense and prolonged analgesia.[5–8] Opioids are commonly added to local anesthetic solutions to increase intensity and duration of anesthesia by acting on opioid receptors present on the nerve terminals.[9,10] However, fentanyl has some side effects as vomiting and respiratory depression.[7] Clonidine is a selective Alpha-2 adrenergic agonist with some Alpha-1 agonist property. In clinical studies, the addition of clonidine to local anesthetic solution improved peripheral nerve blocks by reducing the onset time improving the efficacy of the block during surgery and extending post-operative analgesia.

Aims and Objectives

The present study is aimed to compare the effects of 0.5% Ropivacaine with clonidine (*30 mcg*) and 0.5% Bupivacaine with clonidine (*30 mcg*) in supraclavicular brachial plexus block in terms of:

- The onset of blockade–sensory and motor blockade
- Duration of the blockade–sensory and motor blockade
- Quality of the block

Materials and Methods

The present study titled "A comparative study of Ropivacaine + Clonidine with Bupivacaine + Clonidine in supraclavicular brachial plexus block" was carried out at Kamineni Institute of Medical Sciences, Narketpally, Nalgonda District, Telangana State. It was a prospective and randomized study.

Sixty patients of age group between *18* and *70 years* admitted between August *2018* and *November 2018* were selected for the study. These patients were undergoing elective operative procedures for upper limb surgeries (*i.e.*, elbow, forearm and hand surgeries).

Exclusion criteria included patient's refusal, history of bleeding disorders or patients on anticoagulant therapy, peripheral neuropathy, local infection, respiratory disease, or known allergy to local anesthetic drugs.

Each patient was visited pre-operatively and the procedure was explained and informed written consent was obtained. Investigations like Hemoglobin, Bleeding time, Clotting time, blood grouping, random blood sugar, blood urea, serum creatinine, bleeding time, clotting time, chest *X*-ray, ECG were done.

Each patient was randomly assigned to one of the two groups of 30 patients each, Group BD or Group RD by a computerized randomization.

Group – BC *i.e.*, *30 ml* of Bupivacaine group received 0.5% Bupivacaine according to body weight + clonidine (*30 mcg*).

Group – RC *i.e.*, *30 ml* of Ropivacaine group received 0.5% Ropivacaine according to body weight + clonidine (*30 mcg*).

Each patient was made to lie supine without a pillow, arms at the side, head turned slightly to the opposite side with the shoulders depressed posteriorly and downward by moulding the shoulders over a roll placed between the scapulae. The supraclavicular area was aseptically prepared and draped. The anesthesiologist stands on the side of the patient to be blocked. The patients were administered brachial plexus block by supraclavicular approach under strict aseptic precautions. The injection site was infiltrated with *1 ml* of lidocaine 2% subcutaneously. A nerve stimulator with 50 mm stimuplex needle is used to locate brachial plexus. The location end point being a distal response with an output of 0.4 *mA*. During injection, negative aspiration was performed every *6–7 ml* to avoid intravascular injection. A *3-min* massage was performed to facilitate an even drug distribution.

Time of onset of sensory block was recorded using pinprick in skin dermatomes C4-T2. The same observer assessed the motor block at the

same time.

Onset of sensory block was from the time of injection of drug to time of loss of pain on pinprick. Onset of motor block was from the time of injection to time of complete loss of movement.

Sensory block was assessed by pinprick with a short bevelled 23G needle as:

Grade 0 – Sharp pin prick felt.

Grade 1 – Analgesia, dull sensation felt.

Grade 2 – Anesthesia, no sensation felt.

Motor block was graded according to the modified Bromage scale:

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

Grade 1 – Decreased motor strength, with ability to move only fingers.

Grade 2 – Complete motor block with inability to move elbow, wrist, and fingers.

Duration of sensory blockade was the time in minutes from the onset of analgesia to the recurrence of pain to pin prick. Duration of motor blockade was the time in minutes from the onset of paresis to the recurrence of motor movements.

The quality of the block was graded according to whether opioids were used during intra operative period (Grade II) or if adjuvants of any kind were not used throughout the surgery (Grade I). For the patients who were anxious and perturbed by the sensation of touch on the operating limb, Inj. Fentanyl *50 mcg* IV was administered. The blocks that required conversion to general anesthesia were excluded from the study.

The heart rate, oxygen saturation and mean arterial pressure were recorded. Patients were watched for complications such as bradycardia, convulsions, restlessness, disorientation or drowsiness. All the values were expressed as mean ± standard deviation. Statistical comparison was performed by student's *'t'* test and Chi-Square test.

A *p* - value of > 0.05 was considered to be statistically not significant, a *p* - value 0.05 as statistically significant, a *p* - value of < 0.01 as statistically highly significant and a *p* - value of < 0.001 as statistically very highly significant.

Results

The present study was conducted on 60 consenting patients aged between *18* and *70 years*. Group RC received *30 ml* of 0.5% Ropivacaine + clonidine (*30 mcg*). Group BC received 30 ml of 0.5% Bupivacaine + clonidine (*30 mcg*) for brachial plexus block by supraclavicular approach.

Table 1: Age distribution of patients

Age in Years	Group BC (Bupivacaine + Clonidine)		Group RC (Ropivacaine + Clonidine)	
	Number of Patients	Percent	Number of Patients	Percent(%)
18–24	5	16.67	10	33.33(%)
25–31	12	40	10	33.33(%)
32–38	6	20	2	6.67(%)
39–45	2	6.67	2	6.67(%)
46–52	2	6.67	3	10.00(%)
53–59	1	3.33	1	3.33(%)
60–66	2	6.67	2	6.67(%)
Total	30	100.00	30	100.00(%)
Mean ± SD	31.20 ± 12.59		32.00 ± 13.17	
Minimum	18		18	
Maximum	60		65	

$\chi 2 = 2.348$, p = 0.8850

Table 1 shown in age distribution of the patients in both the groups. The minimum age in both groups was *18 years*. The maximum age in both groups was *60 years* and *65 years* respectively. The mean age in group BC were 31.20 ± 12.59 and RC were 32.00 ± 13.17 respectively. There was no significant difference in the age of patients between the Group BC and Group RC. Both groups were similar with respect to age distribution ($p > 0.05$) shown as in (**Tables 2–8**).

Table 2: Distribution of patients according their sex

Sex	Group BC		Group RC	
	Number of Patients	Percent	Number of Patients	Percent(%)
Male	18	60.00%	21	70.00%
Female	12	40.00%	9	30.00%
Total	30	100.00%	30	100.00%

$\chi 2 = 0.08208$, $p = 0.7745$

No significant difference was observed in sex distribution of the cases between two groups ($p > 0.05$).

Table 3: Showing the weight distribution in each group

Weight	Group BC		Group RC	
	Number of Patients	Percent	Number of Patients	Percent(%)
40–49	12	40	9	30(%)
50–59	11	36.67	15	50(%)
60–69	7	23.33	6	20(%)
Total	30	100	30	100(%)
Mean ± SD	52.93 ± 6.52		53.73 ± 5.45	
Minimum	40		42	
Maximum	68		62	

$\chi 2 = 1.121$, $p = 0.5710$

Table 4: Comparison of onset of sensory and motor blockade

Onset of Block (*min*)	Group BC				Group RC				
	Min	Max	Mean	SD	Min	Max	Mean	SD	
Motor	8	15	12.57	1.9205	7	13	8.07	1.5447	$p = 0.001$
Sensory	6	12	10.37	1.5313	5	12	6.93	1.8557	$p = 0.001$

Table 5: Duration of blockade (*min*)

Duration of Block	Group BC				Group RC				
	Min	Max	Mean	SD	Min	Max	Mean	SD	
Motor	370	480	431.33	32.56	340	480	415.33	36.11	$p = 0.07$
Sensory	390	520	480.33	20.13	380	500	469.67	25.15	$p = 0.07$

The two groups are compared according to their weight. This was statistically not significant ($p > 0.05$).

In Group BC the mean onset time of sensory blockade was 10.37 minutes and motor blockade were 12.57 minutes whereas in Group RC, the mean onset time of sensory blockade was 6.93 minutes and motor blockade were 8.07 minutes.

Onset of sensory and motor blockade was earlier in case of Group RC (Ropivacaine group) when compared with Group BC (Bupivacaine group). The p - value was < 0.01 which is statistically significant.

In group BC the mean duration of sensory blockade was 480.33 minutes and motor blockade were 431.33 minutes when compared to group RC, where sensory blockade duration was 469.67 minutes and duration of motor blockade 415.33 minutes.

The duration of sensory and motor blockade was similar in Group BC when compared to Group RC. There was no statistical difference between the two ($p > 0.05$).

Table 6: Quality of blockade

Class	Group BC	Group RC
1	20	22
2	10	8
Total	30	30

$\chi^2 = 0.31$, $p = 0.57$

In Group BC 20 patients needed no additional drug like opioids (Inj. Fentanyl *50 mcg* IV) when compared with Group RC where 22 patients didn't need any adjuvant. Adjuvants were used in 10 patients in group BC whereas 8 patients needed adjuvants in Group RC.

This is statistically not significant ($p > 0.05$).

Table 8: Mean duration of surgery in minutes

	Group BC				Group RC			
	Min	Max	Mean	SD	Min	Max	Mean	SD
Duration of Surgery	50	130	78.41	21.10	50	130	69.5	19. 3

$p = 0.15$

In group BC, the mean duration of surgery was 78.41 ± 21.10 minutes whereas in group RC the mean duration of surgery was 69.5 ± 19.3 minutes. The mean duration of surgery in Group BC was similar compared to Group RC. The p - value (0.15) was also not statistically significant.

Discussion

Regional anesthetic techniques are used for both operative anesthesia and for post-operative analgesia. They are becoming more popular as a result of advances in drugs, equipment, and improved techniques of anatomical localization, including nerve stimulator and ultrasonic location.[11]

Regional anesthetic techniques may be used alone or in combination with sedation or general anesthesia depending on individual circumstances.[12,13] The advantages of regional techniques include:

- Avoidance of the adverse effects of general anesthesia.
- Post-operative analgesia.
- Preservation of consciousness during surgery.
- Sympathetic blockade and attenuation of the stress response to surgery.
- Improved gastrointestinal motility and reduced nausea and vomiting.
- Simplicity of administration.
- Rapid mobilization of patient and early discharge decreases DVT.

- More economical for the patient.

The net effect of these features leads to a reduction in the incidence of major post-operative respiratory complication. The upper limb is well suited to regional anesthetic techniques and these remain among the most useful and commonly practiced peripheral regional techniques. Supraclavicular block offers dense anesthesia of brachial plexus for surgical procedures at or distal to the elbow. This approach provides perhaps the best overall efficacy of complete arm block from a single injection as the trunks/divisions of the brachial plexus are closely related at this point.[14,15,16]

For a long-time, the choice of local anesthetic for brachial plexus block was Bupivacaine, a long-acting amide local anesthetic. However, concerns about its high lipid solubility and high cardiotoxicity limited its use. With the advent of newer and safer long-acting amide local anesthetics such as Ropivacaine and Levobupivacaine, Bupivacaine has largely been replaced. Ropivacaine has lower lipid solubility and produces less central nervous toxicity and cardiotoxicity than Bupivacaine. It has been shown that Ropivacaine interferes with mitochondrial respiration and ATP synthesis less than both racemic bupivacaine and Levobupivacaine. Ropivacaine is thus gaining popularity over Bupivacaine for peripheral nerve blocks.[17,18]

There has been a search for an ideal adjuvant to local anesthetics for regional nerve block that prolongs the analgesia with lesser side effects. Several adjuncts have been described to decrease the time of onset to the block and to prolong the duration of the block. Drugs such as opioids, Dexmethasone, Tramadol, Neostigmine, Epinephrine, Dexmedetomidine and Clonidine have been used as adjuncts to brachial plexus blocks.[19]

Evidence regarding the analgesic benefit of opioid adjuncts remains equivocal. There appears to be no advantage for reduced adverse effects by the peripheral administration of opioid analgesics. Nausea, vomiting and pruritis occurred even with the peripheral administration of opioids.

Sufficient data is not available to allow the recommendation of tramadol and neostigmine as adjuncts to local anesthetics in brachial plexus block. Clonidine enhances both sensory and motor blockade of neuraxial and peripheral nerves after injection of local anesthetic solutions. There have been four proposed mechanisms for the action of clonidine in peripheral nerve blocks. These mechanisms are centrally mediated analgesia, alpha-2-adrenoreceptor mediated vasoconstriction, attenuation of inflammatory response and direct action on peripheral nerve. Clonidine possibly enhances or amplifies the sodium channel blocking action of local anesthetics by opening up the potassium channels resulting in hyperpolarization, a state in which the cell is unresponsive to excitatory input.[20]

The present study is undertaken to compare the onset, duration of sensory and motor block and the quality of block achieved by Bupivacaine with clonidine and Ropivacaine with clonidine. Supraclavicular brachial plexus block was administered in 60 patients selected randomly for elective and emergency surgeries. 0.5% Bupivacaine was administered with clonidine (*30 mcg*) to 30 patients selected randomly and 0.5% Ropivacaine was administered with clonidine (*30 mcg*) to 30 patients selected randomly.

Conclusion

From our study, we concluded that addition of Clonidine (*30 mcg*) to 0.5% Ropivacaine in supraclavicular brachial plexus block has following advantages compare to bupivacaine with clonidine Faster onset of analgesia, sensory and motor blockade:

1. Less cardiac Toxicity.
2. No significant Difference in hemodynamic parameters (pulse rate, Blood pressure; SpO_2 and respiratory rate) and no significant side effects and complications.

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