

Comparative evaluation of the effects of adjuvant clonidine to ropivacaine with solo ropivacaine for axillary brachial plexus block

Ranjeet Kumar Bihari¹, Deepak Kumar², Praveen Kumar Tiwary³

¹Senior Resident, Department of Anesthesia and Critical Care, RIMS, Ranchi, India

²Senior Resident, Department of Anesthesia and Critical Care, RIMS, Ranchi, India

³Associate Professor, Department of Anesthesia and Critical Care, RIMS, Ranchi, India

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Abstract

Background: Ropivacaine is a long acting amide local anaesthetic agent. It is a pure S-enantiomer while bupivacaine is a racemic mixture. Ropivacaine causes reversible inhibition of sodium ion influx, and thereby blocks impulse conduction in nerve fibres. This action is potentiated by dose-dependent inhibition of potassium channels. **Aim:** To study the effects of adjuvant clonidine to ropivacaine with solo ropivacaine for axillary brachial plexus block. **Materials and Methods:** This study was conducted on 60 patients undergoing upper limb surgeries aged between 18 to 55 years under supraclavicular block. Informed written consent was taken. Result values were recorded using a preset proforma. **Results:** There were 24 patients in Group R and 23 patients in Group RC belonging to ASA Grade I, and 6 patients in Group R and 7 patients in Group RC belonging to ASA Grade II which was considered statistically not significant. **Conclusion:** The combination produces improved analgesia, resulting in a prolonged effect and stable hemodynamics.

Keywords: Clonidine, Ropivacaine, Hemodynamic Variables.

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Introduction

Knowledge of formation of brachial plexus and its ultimate cutaneous and muscular distribution is absolutely essential to the intelligent and effective use of brachial plexus anaesthesia for upper limb surgeries. Close familiarity with the vascular, muscular and fascial relationships of the plexus is equally essential to the mastery of various techniques, for it is these perineural structures which serve as the landmark by which needle may accurately locate the plexus percutaneously.[1]

In its course from intervertebral foramina to the upper arm, the fibres are composed consecutively of roots, trunks, divisions, cords and terminal nerves. KULENKAMPFF described the first percutaneous supraclavicular approach. He pointed out that above the clavicle the plexus lies under the skin as it passes over the first rib and accessible to a percutaneous technique. The midpoint of the clavicle and subclavian artery provided a constant landmark. Most frequently at the point where external jugular vein intersects the clavicle. He performed his first attempt on himself and used 5 ml of Novocaine, later he increased it to 10 ml and was able to obtain complete anaesthesia. Direction of the needle was backwards, inwards and downwards. He emphasized that purpose of the technique was not to hit the rib but to find the trunks by eliciting paraesthesia. He said the rib just prevented pleural penetration. He used 4 cm needle.[2]

LABAT in 1922, advocated an injection at three separate points which failed to elicit paraesthesia by Kulenkampff's method.[3] LIVINGSTON, carried out Kulenkampff's technique without the production of paraesthesia and mentioned that the plexus and the

artery are separated from the surrounding structures by a fascial investment.[4] PATRICK's technique became the "standard technique" of supraclavicular block, subsequently referred to by many as the "classical supraclavicular technique".[5] KNIGHT modified Patrick's technique by making the three injections through three separate needle insertion, parallel to one another.[6] MURPHEY used a single injection technique and used lateral border of anterior scalene muscle as the landmark.[7] BONICA and MOORE utilized Kulenkampff's and Patrick's techniques and developed a new technique that was used over subsequent twenty years.[8] LOOKMAN dissected the plexus and FORTIN and TREMBLAY advocated the use of a short needle.[9] In 1964 WINNIE after numerous anatomical dissections showed that the relation of the plexus and the subclavian artery to the midpoint of the first rib is not constant. He showed that there is a constant relationship between the anterior and middle scalene muscles, the plexus and the first rib. The plexus between the two scalene muscles always insert on the first rib. He inserted needle between the two muscles, in the direction of the space between them. Once a paraesthesia is obtained, a single injection is made into the space.[10] Ropivacaine is a long acting amide local anaesthetic agent. It was first synthesised in 1957 along with bupivacaine and mepivacaine. It is a pure S-enantiomer while bupivacaine is a racemic mixture. Ropivacaine causes reversible inhibition of sodium ion influx, and thereby blocks impulse conduction in nerve fibres. This action is potentiated by dose-dependent inhibition of potassium channels. Ropivacaine is less lipophilic than bupivacaine and is less likely to penetrate large myelinated motor fibres; therefore it has selective action on the pain transmitting A delta and C nerves rather than A-beta fibres, which are involved in motor function.[11] Ropivacaine is less lipophilic than bupivacaine and that, together with stereoselective properties contributes to ropivacaine having a significantly higher threshold for cardiotoxicity and CNS toxicity than bupivacaine.[12] The CNS effects occurred earlier than

*Correspondence

Dr.Praveen Kumar Tiwary

Associate Professor, Department of Anesthesia and Critical Care, RIMS, Ranchi, India

E-mail: drpkt80@gmail.com

cardiotoxic symptoms during an intravenous infusion of local anaesthetic (10mg/kg) in human volunteers and the infusion was stopped at this point. Significant changes in cardiac function involving the contractility, conduction time and QRS width occurred and the increase in QRS width was found to be significantly smaller with Ropivacaine than Bupivacaine. Therefore this study was undertaken to study the effects of adjuvant clonidine to ropivacaine with solo ropivacaine for axillary brachial plexus block.

Materials and Methods

This prospective randomized study was conducted at Department of Anesthesia and Critical Care, at RIMS, Ranchi. The study was approved by the institutional research and ethical committee. The study was conducted between September 2019 and March 2020. An informed and written consent was taken from the participating subjects prior to the commencement of the study.

This study was conducted on 60 patients undergoing upper limb surgeries aged between 18 to 55 years under supraclavicular block. Informed written consent was taken. Result values were recorded using a preset proforma.

Inclusion criteria:

1. Patients with ASA Class I & II
2. Patients aged between 18 to 55 years.
3. Patients with SBP 100- 139mm of Hg.
4. Patients with DBP 60-89mm of Hg.

Exclusion criteria:

1. Patients belonging to ASA Class III & IV.
2. Known cause of hypersensitive reaction to Clonidine.
3. Patients with medical complications like severe anemia, severe hypovolemia, shock, and septicemia.
4. Patients with abnormal BT, CT or on anticoagulant therapy.
5. Local infection at the site of proposed puncture for supraclavicular block.

Results

Sixty ASA I and II of either sex aged between 18-55 years, posted for upper limb surgeries under supraclavicular brachial plexus block were selected for the study. The study was undertaken to evaluate the efficacy of Clonidine (150µg) as adjuvant to Ropivacaine (0.75%) in comparison with plain Ropivacaine (0.75%) for brachial plexus block by supraclavicular approach.

Table 1: Age distribution of patients studied.

Age in years	Ropivacaine		Ropivacaine+Clonidine	
	No	%	No	%
<20	2	6.7	4	13.3
20-30	10	33.3	12	40.0
31-40	11	36.7	4	13.3
41-50	7	23.3	8	26.7
51-60	0	0.0	2	6.7
Total	30	100.0	30	100.0
Mean ± SD	33.87±9.86		33.67±11.59	

The minimum age of the patient was 18 years and the maximum age was 55 years. The mean age of the patients in group R was 33.87± 9.86 and in group RC was 33.67± 11.59 years. Age incidences between two groups were comparable.

Table 2: ASA Grade distribution in two groups of patients studied

Age in years	Group R		Group RC	
	No	%	No	%
Grade I	24	80.0	23	76.7
Grade II	6	20.0	7	23.3
Total	30	100.0	30	100.0

Table 3: Pulse rate (beats/min)

Pulse rate (beats/min)	Group R	Group RC	P value
0 min	76.10±8.15	77.47±7.83	0.510
5 min	76.03±7.86	77.53±7.42	0.450
15 min	75.97±7.84	77.47±7.30	0.446
30 min	76.07±8.07	76.70±7.84	0.759
60 min	76.37±7.69	77.63±7.92	0.532
2 hrs	76.13±7.94	77.10±7.92	0.639
6 hrs	76.17±8.18	77.53±7.19	0.495
12 hrs	76.20±8.12	77.77±7.72	0.447
24 hrs	76.27±8.27	77.87±7.25	0.429

There were 24 patients in Group R and 23 patients in Group RC belonging to ASA Grade I, and 6 patients in Group R and 7 patients in Group RC belonging to ASA Grade II which was considered statistically not significant. Pulse rate, systolic BP, diastolic BP, O₂ saturation was recorded at 0 min, 5 min, 15 min, 30 min, 60 min, 2 hours, 6 hours, 12 hours, 24 hours.

In group R, the mean pulse rate ranged from 75± 7.84 to 76± 7.69 beats / min. In group RC, the mean pulse rate ranged from 76± 7.84 to 77± 7.25 beats / min. The statistical analysis by student's unpaired „t“ test showed that there was no significant difference in pulse rate between the two groups (P > 0.05).

Table 4: Systolic blood pressure (mm of Hg)

Systolic blood pressure (mm Hg)	Group R	Group RC	P value
0 min	117.80±9.52	117.40±9.51	0.871
5 min	117.73±9.26	117.13±9.68	0.807
15 min	117.53±9.15	117.33±9.86	0.935
30 min	117.80±9.44	117.20±9.64	0.808
60 min	117.40±9.53	117.40±9.57	1.000
2 hrs	117.60±9.49	117.27±9.37	0.892
6 hrs	117.73±9.51	117.33±9.46	0.871

12 hrs	117.87±9.39	117.27±9.72	0.809
24 hrs	117.73±9.41	117.47±9.63	0.914

In group R, the mean systolic blood pressure ranged from 117.40±9.53 to 117.80±9.52 mm of Hg. In group RC, the mean systolic blood pressure ranged from 117.13±9.68 to 117.47±9.63 mm of Hg.

The statistical analysis by unpaired student's t test showed that there was no significant difference in systolic blood pressure between the two groups ($P > 0.05$).

Table 5: Comparison of Diastolic blood pressure (mm Hg) in two groups of patients studied

Diastolic blood pressure (mm Hg)	Group R	Group RC	P value
0 min	74.27±6.12	74.33±5.68	0.965
5 min	74.60±6.08	74.27±5.45	0.824
15 min	74.53±6.03	74.53±5.87	1.000
30 min	74.47±5.67	74.27±5.98	0.895
60 min	74.40±5.67	74.27±5.82	0.929
2 hrs	74.27±5.94	74.20±5.67	0.965
6 hrs	74.2±5.86	74.00±5.68	0.894
12 hrs	74.13±6.06	74.60±5.49	0.756
24 hrs	74.00±6.17	74.60±5.10	0.683

In group R, the mean diastolic blood pressure ranged from 74±6.17 to 74.60±6.08 mm of Hg. In group RC, the mean diastolic blood pressure ranged from 74±5.68 to 74.60±5.49 mm of Hg. The statistical analysis by student's unpaired t test showed that there was no significant difference in diastolic blood pressure between the two

groups ($P > 0.05$). In group R, the mean O_2 saturation ranged from 98±0.5% to 99±0.57%. In group RC, the mean O_2 saturation ranged from 98±0.5%. The statistical analysis by students unpaired t test showed that there was no significant difference in O_2 saturation between the two groups ($P > 0.05$).

Table 6: Comparison of Oxygen saturation (%) in two groups of patients studied

Oxygen saturation (%)	Group I	Group II	P value
0 min	98.73±0.45	98.67±0.48	0.581
5 min	98.70±0.47	98.77±0.43	0.567
15 min	98.73±0.45	98.70±0.47	0.779
30 min	98.77±0.43	98.53±0.51	0.060+
60 min	98.77±0.43	98.67±0.48	0.399
2 hrs	98.53±0.51	98.77±0.43	0.060+
6 hrs	98.60±0.50	98.67±0.48	0.599
12 hrs	98.63±0.49	98.63±0.49	1.000
24 hrs	98.63±0.49	98.77±0.43	0.267

Discussion

Brachial plexus block provides postoperative analgesia of short duration, even when a long-acting local anaesthetic like Ropivacaine is used alone. Various adjuvant drugs like Opioids, Midazolam, Neostigmine and Hyaluronidase have been evaluated in conjunction with local anaesthetics to prolong the period of analgesia,[13] but they were found to be either ineffective or to produce an unacceptably high incidence of adverse effects. Clonidine is known to produce antinociception and to enhance the effect of local anaesthetic when administered intrathecally and epidurally. Clonidine produces this effect by its action on Alpha 2 adrenergic receptors found in peripheral nerves. Mehdi Trifa et al,[14] added clonidine to ropivacaine in axillary plexus block in children undergoing upper limb surgery and found that addition of clonidine increased the time to first analgesia request. Clonidine produces this additive effect on local anaesthetics by its action on the presynaptic alpha-2 receptor complexes present on peripheral nerves. Murphy et al,[11] analysed the usefulness of a variety of adjuvants including clonidine added to local anaesthetics for brachial plexus block and concluded that clonidine in doses upto 150g increased the duration of postoperative analgesia with minimal adverse effects. Danelli G et al,[15] evaluated the effects of adding clonidine to ropivacaine for superficial cervical plexus block in patients undergoing elective carotid endarterectomy and found that adding clonidine to ropivacaine shortened the onset time and improved the quality of surgical anaesthesia. Casati et al,[16] added clonidine to ropivacaine in sciatic femoral nerve block for foot surgery and found that addition of clonidine to 0.75% Ropivacaine prolongs the duration of postoperative analgesia with only a slight and short lived increase in degree of sedation and no hemodynamic adverse effects.

The prolonged analgesia in Group RC could be due to the action of Clonidine by inhibiting action potential of A & C fibers in peripheral nerves as demonstrated by Gaumann et al.[17] Many authors favor the hypothesis that Clonidine exerts its local anesthetic-prolonging effect directly on nerve fiber, as a result of complex interaction between Clonidine and axonal ion channels or receptors. Masuki et al.[18], suggested Clonidine may produce local vasoconstriction resulting in a delayed absorption of local anesthetic and block prolongation. Butterworth et al.[19] found Clonidine to produce tonic and phasic block of nerve conduction in rat sciatic nerve fibers by directly binding to Alpha-2 adrenergic receptors on presynaptic peripheral nerves to modify neuronal excitability.

We studied Clonidine at a dose of 150 µg as others have used the same dosage in peripheral nerve block without any significant adverse effects. El Saied et al showed that addition of 150 µg of clonidine to ropivacaine for brachial plexus blockade prolongs motor and sensory block and analgesia, without an increased incidence of side effects. Bernard et al evaluated effects of adding 30-300 mcg Clonidine to local anesthetic for brachial plexus block and found it is hemodynamically safe upto 150 mcg. A similar observations were made by Singelyn et al.[19] who suggested 0.5-1 mcg/kg of clonidine satisfactorily prolongs the analgesia of local anesthetic in peripheral nerve blocks without undue hemodynamic side effects of alpha-2 agonism.

Conclusion

No significant difference in haemodynamic variables i.e., pulse rate, systolic BP, diastolic BP and O_2 saturation.

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