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

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ABSTRACT

Introduction: Regional nerve blocks are based on the concept that the pain is conveyed by nerve fibres which are amenable to interruption anywhere along their pathway. Bupivacaine is commonly used in brachial plexus blocks because of its longer duration of action compared to Ropivacaine. So the present study was aimed to compare the effects of 0.75% Ropivacaine with Clonidine and 0.5% Bupivacaine with Clonidine in supraclavicular brachial plexus block.

Materials and methods: was a prospective and randomized study.Sixty patients of age group between 18 and 70 years admitted between December 2013 and July 2015 were selected for the study.Each patient was randomly assigned to one of the two groups of 30 patients each, group BC or group RC by a computerized randomization. Group – BC i.e., Bupivacaine group received 0.5% Bupivacaine according to body weight + 1.5 mcg/kg Clonidine. Group – RC i.e., Ropivacaine group received 0.75% Ropivacaine according to body weight + 1.5 mcg/kg Clonidine. Onset of sensory and motor blockade, duration of sensory and motor blockade and quality of block were assessed.

Results: The mean age in Group BC was 31.20 ± 12.59 and RC was 32.00 ± 13.17 respectively. There was no significant difference in the age of patients and gender distribution between the Group BC and Group RC. 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 onset time of sensory block, motor block with Bupivacaine and Clonidine is 10.37 ± 1.53 minutes, 12.57±1.92 minutes whereas mean onset of sensory block, motor block with Ropivacaine and Clonidine is 6.93± 1.86 minutes, 8.07 ± 1.54 minutes respectively.The mean duration of sensory block, motor block withBupivacaine and Clonidine is480.33± 20.13 minutes, 431.33± 32.56 minuteswhereasthe mean duration of sensory block, motor block with Ropivacaine and Clonidine is 469.67± 25.15 minutes, 415.33 ± 36.11 minutes respectively.

Conclusion: Ropivacaine and Clonidine can be used in supraclavicular brachial plexus block in view of its faster onset of action and similar duration of action compared with Bupivacaine and Clonidine, and similar quality of block. Ropivacaine, being lesscardiotoxic is a good alternative to Bupivacaine.

Keywords: Supraclavicular Brachial Plexus Block, Bupivacaine, Ropivacaine

INTRODUCTION

Pain is one of mankind's oldest and most dreaded maladies. Despite increased knowledge and scientific advances, the diagnosis and effective treatment of pain remains one of the most formidable challenges with many difficulties and pitfalls. Regional nerve blocks are based on the concept that the pain is conveyed by nerve fibres which are amenable to interruption anywhere along their pathway. The idea that pain is conducted and modulated in the nervous system, originated with the specific theory of Johannes P Muller, described in 1826. This was followed by the alternate intensity theory of Erb in 1874; an idea that later culminated in the gate control theory of pain by Melzack and Wall in 1965.

In 1855, Rynd described the idea of introducing a solution of morphine hypodermically around a peripheral nerve. Wood, in 1855 was the first person to perform a subcutaneous injection with a graduated glass syringe and a hollow needle, a device developed initially by Pravaz for injection of ferric chloride into an aneurysm to produce coagulation.[1]

Trephination was practiced by Incas, and their tradition holds that the 'Shaman', performing the procedure chewed Cocoa Leaves and Spat into the wound producing local anaesthetic effect.[2]

In 1881, Carl Koller demonstrated ocular surface anaesthesia with cocaine.[3] Ester local anesthetics which were developed later lost their value due to short duration of action, allergic reaction and systemic toxicity. Later, amide anesthetics were synthesized. In the recent years peripheral nerve blocks are gaining importance for their longer duration of action, quality of block and post–operative analgesic effect. It also avoids the side effects of general anaesthesia.

Bupivacaine is commonly used in brachial plexus blocks because of its longer duration of action compared to Lignocaine.[4] Concerns have been raised about the cardiotoxic effects of Bupivacaine after accidental IV injection. Bupivacaine cardiotoxicity was more resistant to resuscitation compared to other local anaesthetics.[4-6]

Studies have found out that commercial Bupivacaine is a racemic mixture of *(R)* - and *(S)* -stereoisomers.[7] The cardiac toxic effects were attributed to the dextro*(R)* isomer while its pharmacologic effects were achieved by its levo*(S)* isomer. In response to the problem of cardiovascular toxicity as a result of accidental intravascular injection of Bupivacaine, single enantiomers like Ropivacaine[8] and Levo-*(S)*-bupivacaine[9]

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were developed. These have less cardiotoxicity on milligram to milligram basis in animal studies[4,10,11], and data in human studies have also shown that the potential of Ropivacaine to produce central nervous system and cardiotoxicity is less.[12,13] The cardiotoxicity of Ropivacaine and Levobupivacaine was more amenable for resuscitation compared to Bupivacaine.[4,5] Ropivacaine provides a better differential block between sensory and motor block when given epidurally. It has a shorter duration of action and is less potent than Bupivacaine.[14]

To prolong the duration of the major nerve blocks, several adjuvants have been used such as epinephrine, bicarbonate, opioids, clonidine and neostigmine.[15] Clonidine has been shown to be a valuable adjuvant to major nerve blocks. It is an alpha – 2 receptor agonist and has been shown to reduce the time of onset to the block and provide better quality of anaesthesia.[16,17]

We made an attempt to compare the clinical characteristics of Ropivacaine with Clonidine and Bupivacaine with Clonidine used while giving brachial blocks.

The present study is aimed to compare the effects of 0.75% Ropivacaine with Clonidine and 0.5% Bupivacaine with Clonidine in supraclavicular brachial plexus block in terms of: the onset of blockade – sensory and motor blockade, Duration of the blockade – sensory and motor blockade and Quality of the block.

MATERIAL AND METHODS

The present study comparative study of Ropivacaine and Clonidine with Bupivacaine and Clonidine in supraclavicular brachial plexus block. It was a prospective and randomized study.Sixty patients of age group between 18 and 70 years admitted between December 2013 and July 2015 were selected for the study.

Patients undergoing elective operative procedures for upper limb surgeries (i.e. elbow, forearm and hand surgeries) were included in the study.

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 complete blood count, blood grouping, urine examination for albumin, sugar and microscopy, 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 BC or group RC by a computerized randomization.

Group – BC i.e., Bupivacaine group received 0.5% Bupivacaine according to body weight + 1.5 mcg/kg Clonidine

Group – RC i.e., Ropivacaine group received 0.75% Ropivacaine according to body weight + 1.5 mcg/kg Clonidine

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 anaesthesiologist stands on the side of the patient to be blocked.

An intradermal wheal was raised with local anesthetic approximately 1cm above the midclavicular point. The subclavian artery palpable in supraclavicular fossa was used as landmark. The tip of index finger was rested in supraclavicular fossa directly over the arterial pulsation. A filled 10ml syringe with a 23 gauge, 32mm needle attached was held in right hand and connected to the nerve stimulator. The nerve stimulator needle was inserted through skin and advanced slowly downward (caudal) rolled slightly inward (medially) and slightly backward (posteriorly).

As soon as muscle twitches were elicited at 0.5 mA, the needle was fixed in position and after confirming negative aspiration of blood, the respective drug was injected depending on whether the patient as allotted to either of group BC or RC.

Time of onset of sensory block was recorded using pinprick in skin dermatomes C4-T2 once in every 1 minute until onset of the block for a maximum of 30 minutes after injection and thereafter every 30 minutes till patient regained normal sensations. The same observer assessed the motor block at same time intervals.

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 beveled 23G needle as

Grade 0 – Sharp pin prick felt

Grade 1 – Analgesia, dull sensation felt

Grade 2 – Anaesthesia, 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 graded based on 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, respiratory rate and blood pressure were recorded at intervals of 5 minutes. Patients were watched for complications such as bradycardia, convulsions, restlessness, disorientation or drowsiness.

STATISTICAL ANALYSIS

All the values were expressed as mean and 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 18-70 years. Group RC received 30ml of 0.75% Ropivacaine + 1.5 mcg/kg Clonidine. Group BC received 30 ml of 0.5% Bupivacaine + 1.5 mcg/kg Clonidine for brachial plexus block by supraclavicular approach.

Table-1 shows 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 was 31.20 ± 12.59 and RC was 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).

No significant difference was observed in sex distribution of the cases between two groups (P>0.05). 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 was 12.57 minutes whereas in group RC, the mean onset time of sensory blockade was 6.93 minutes and motor blockade was 8.07 minutes (table-2).

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 < 0.001 which is statistically significant.

In group BC the mean duration of sensory blockade was 480.33 minutes and motor blockade was 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).

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.

In Class I, 20 patients needed no additional drug like opioids (Inj. Fentanyl 50 mcg IV) when compared with Class II where 22 patients didn't need any adjuvant. Adjuvants were used in 10 patients in group I whereas 8 patients needed adjuvants in Group II. This was statistically not significant (p > 0.05) (table-3). Table 4 shows distribution of patients according to the diagnosis.

DISCUSSION

Regional anesthetic techniques are used for both operative anaesthesia and for postoperative analgesia. They are becoming more popular as a result of advances in drugs, equipment, and

S. No	Variable	Group BC (BUPIVACAINE+CLONIDINE)		Group RC (ROPIVACAINE+CLONIDINE)	
1	Age distribution in years	Number	Percentage	Number	Percentage
	18-24	12	40	10	33.33
	25-31	6	20	10	33.33
	32-38	5	16.67	3	10
	39-45	2	6.67	2	6.67
	46-52	1	3.33	2	6.67
	53-59	2	6.67	1	3.33
	60-66	2	6.67	2	6.67
	Mean±SD	31.20 ± 12.59		32.00 ± 13.17	
	Minimum	18		18	
	Maximum	60		65	
2	Sex distribution				
	Male	21	70%	22	73%
	Female	9	30%	8	26.7%
3	Weight distribution				
	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	

Table-1: Demographic details of patients in the study.

S. No	Variable	Group BC				Group RC			
1	Onset of Block (min)	Min	Max	Mean	S.D	Min	Max	Mean	S.D
	Motor	8	15	12.57	1.9205	7	13	8.07	1.5447
	Sensory	6	12	10.37	1.5313	5	12	6.93	1.8557
2	Duration of Block								
	Motor	370	480	431.33	32.56	340	480	415.33	36.11
	Sensory	390	520	480.33	20.13	380	500	469.67	25.15
3	Duration of surgery	50	130	78.41	21.10	50	130	69.5	19.3

Table-2: Data of onset, duration of block and duration of surgery in both groups.

S. No	Quality of Block	Group BC	Group RC
1	Class 1	20	22
2	Class 2	10	8
3	Total	30	30

Table-3: Quality of blockade

S. No	Diagnosis	Group BC	Group RC
1	Crush injury	7	7
2	Fracture both bones forearm	8	8
3	Fracture radius	9	11
4	Fracture ulna	1	1
5	Others	5	3
6	Total	30	30

Table-4: Distribution of patients according to the diagnosis

improved techniques of anatomical localization, including nerve stimulator and ultrasonic location.

Regional anaesthetic techniques may be used alone or in combination with sedation or general anaesthesia depending on individual circumstances. The advantages of regional techniques include:

- Avoidance of the adverse effects of general anesthesia
- Postoperative 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
- More economical for the patient

The net effect of these features lead to a reduction in the incidence of major postoperative respiratory complication.

The upper limb is well suited to regional anaesthetic 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

The choice of local anaesthetic to be used in a brachial block was Bupivacaine, a long acting amide local anaesthetic. 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 Levo bupivacaine, 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 levo bupivacaine. Ropivacaine is thus gaining popularity over Bupivacaine for peripheral nerve blocks.

There has been a search for an ideal adjuvant to local anaesthetics 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, dexamethasone, tramadol, clonidine, neostigmine, epinephrine and bicarbonate have been used as adjuncts to brachial plexus blocks.

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 anaesthetics in brachial plexus block.[15]

The analgesic properties of Clonidine, an alpha 2 agonist, when administered intrathecally or epidurally as an adjuvant has been well demonstrated. Several authors have found that Clonidine, when added to local anaesthetic in brachial plexus block in doses up to 150 mcg, hastens the onset, prolongs the motor and sensory block and analgesia without an increased incidence of side effects. Hence, Clonidine has been used in the present study as an adjuvant to the brachial plexus blocks administered.

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 1.5 mcg/kg of Clonidine to 30 patients selected randomly and 0.75% Ropivacaine was administered with 1.5 mcg/kg Clonidine to 30 patients selected randomly.

This study was conducted at MediCiti Institute of Medical Sciences, Ghanpur, Medchal between December 2013 to June 2015.

Both the groups were comparable with regards to mean age, sex, and weight. The present study is compared to three other recent studies done by Anupreet Kaur et al[18], Sidharth SR et al[17], and Chakraborty S et al.[19]

Anupreet Kaur et al carried out a study in 50 patients randomly allocated to two groups of 25 each. Group I received 30 ml 0.5% Bupivacaine and Group II received 30 ml 0.5% Ropivacaine in axillary brachial plexus block for forearm surgeries. The onset, duration of sensory and motor block was recorded.[18]

Sidharth SR et al evaluated the effect of Clonidine on Ropivacaine, for supraclavicular brachial plexus blockade. They performed supraclavicular brachial plexus block on 80 patients. Group A had 40 patients and were given 35 ml 0.5% Ropivacaine and 150 mcg Clonidine while Group B had 40 patients who were given 35 ml 0.5%.[17] Ropivacaine with 1 ml of normal saline. The onset and duration of sensory and motor block was assessed every 5 minutes until 30 minutes and at 15 minute intervals thereafter.

Chakraborty S et al conducted a study on 70 patients undergoing upper limb orthopedic procedures. Group A had 35 patients who received 25 ml of 0.5% Bupivacaine and 0.2 ml (30 mcg) Clonidine. Group B had 35 patients who received 25 ml of 0.5% bupivacaine and 0.2 ml normal saline. The onset and duration of both sensory and motor blocks and sedation score were recorded.[19]

Age and gender distribution

The mean age of the Bupivacaine and Clonidine group in the present study is 31.20 ± 12.59 years, which is comparable to the mean age of Bupivacaine and Clonidine group in the study of

Anupreet Kaur et al, which is 36.60 ± 14.03 years.[18]

The mean age of the Ropivacaine and Clonidine group in the present study is 32.00 ± 13.17 years, which is comparable to the mean age of the Ropivacaine and Clonidine group in the study of Anupreet Kaur et al, which is 33.12 ± 10.72, and the study of Sidharth SR at el, which is 30.6 ± 10.2.

In the present study, the gender distribution in Bupivacaine with Clonidine group is 70%: 30% and in the Ropivacaine with Clonidine group is 73.3%: 26.7%, which is not statistically significant, and is comparable to Anupreet Kaur et al[18] study and Sidharth SR et al study respectively.

Weight distribution

In the present study, the mean weight in the Bupivacaine + Clonidine group is 52.93± 6.52 kg which is comparable to Chakraborty S et al (55.9± 6.81 kg).[19]

In the present study, the mean weight in the Ropivacaine + Clonidine group is 53.73± 5.45 kg which is comparable to a study by Sidharth SR et al (60.4± 11.42 kg).

Onset of sensory and motor blockade

In the present study, the mean onset time of sensory block with Bupivacaine and Clonidine is 10.37 ± 1.53 minutes. In the study done by Anupreet Kaur et al the mean onset time of sensory block with plain Bupivacaine was 12.04± 2.57 minutes. This is due to the addition of Clonidine, as it decreases the time to onset of sensory block.[18]

In the present study, the mean onset time of sensory block with Ropivacaine and Clonidine is 6.93± 1.86 minutes. In the study done by Anupreet Kaur et al,[18] the mean onset time of sensory block with plain Ropivacaine was 8.88± 1.74 minutes. This is due to the addition of Clonidine to Ropivacaine, which decreases the time to onset of sensory block.

In the present study, the mean onset of motor block with Bupivacaine and Clonidine is 12.57± 1.92 minutes. In the study done by Anupreet Kaur et al, the mean onset of motor block with plain Bupivacaine was 22.92± 3.79 minutes. This is due to the addition of Clonidine in the present study, which decreases the time to onset of motor block.[18]

In the present study, the mean onset of motor block with Ropivacaine and Clonidine is 8.07± 1.54 minutes. In the study done by Anupreet Kaur et al, the mean onset of motor block with plain Ropivacaine was 18.55± 7.64 minutes. This is due to the addition of Clonidine in the present study, which decreases the time to onset of motor block.

Duration of sensory and motor blockade

In the present study, the mean duration of sensory block with Bupivacaine and Clonidine is 480.33± 20.13 minutes. In the study conducted by Anupreet Kaur et al, the mean duration of sensory block was 450.40± 54.50 minutes. The p value is 0.007 which is statistically significant. This shows that Clonidine prolongs the duration of sensory block when added to 0.5% Bupivacaine.[18]

In the present study, the mean duration of sensory block with Ropivacaine and Clonidine is 469.67± 25.15 minutes. In the study conducted by Anupreet Kaur et al, the mean duration of sensory block was 421.20± 38.33 minutes. The p value is <0.001 which is statistically significant. This shows that Clonidine prolongs the duration of sensory block when added to 0.75% Ropivacaine.[18]

In the present study, the mean duration of motor block with Bupivacaine and Clonidine is 431.33± 32.56 minutes. In the study conducted by Anupreet Kaur et al, the mean duration of motor block was 408.40± 50.39 minutes. The p value 0.04 which is statistically significant. This shows that Clonidine prolongs the duration of motor block when added to 0.5% Bupivacaine.[18]

In the present study, the mean duration of motor block with Ropivacaine and Clonidine is 415.33± 36.11 minutes. In the study conducted by Anupreet Kaur et al.[18] the mean duration of motor block was 365.60± 34.29 minutes. The p value is less than 0.01, which is statistically significant. This shows that Clonidine prolongs the duration of motor block when added to 0.75% Ropivacaine.

CONCLUSION

On the basis of this study we can conclude that Ropivacaine and Clonidine can be used in supraclavicular brachial plexus block in view of its faster onset of action and similar duration of action compared with Bupivacaine and Clonidine, and similar quality of block. Ropivacaine, being lesscardiotoxic is a good alternative to Bupivacaine. Clonidine is a good adjuvant in brachial plexus block as it hastens the onset of block and prolongs the duration of block, reduces patient anxiety and improves patient comfort level intra operatively as well as post operatively.

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