

COMPARISON STUDY OF BUPIVACAINE, LEVOBUPIVACAINE AND ROPIVACAINE IN AXILLARY BRACHIAL PLEXUS BLOCK: A CLINICAL STUDY

Shikha Mehrotra¹, Hansraj Baghel², Deepesh Gupta³

¹Professor, Department of Anaesthesia, Gandhi Medical College, Bhopal.

²Former Post Graduate Student, Department of Anaesthesia, Gandhi Medical College, Bhopal.

³Associate Professor, Department of Anaesthesia, Gandhi Medical College, Bhopal.

ABSTRACT

AIM

Aim of our study was to assess effect of 0.5% bupivacaine, 0.5% levobupivacaine and 0.5% ropivacaine in axillary brachial plexus block.

OBJECTIVE

To compare the onset time and duration of sensory and motor blockade of 0.5% bupivacaine, 0.5% levobupivacaine and 0.5% ropivacaine in axillary brachial plexus.

MATERIAL AND METHOD

Ninety patients of ASA I and II of age group 20yrs-60yrs of either sex were included in our study undergoing upper limb surgeries in Gandhi Medical College and Hamidia Hospital, Bhopal (MP). The patients were randomly divided into three groups:- Group I (n= 30) : Bupivacaine 0.5%-5mg/ml-30ml, Group II (n= 30) : Levobupivacaine 0.5%-5mg/ml -- 30ml, Group III (n=30) : Ropivacaine 0.5%-5mg/ml -- 30ml onset time of sensory and motor block, duration of sensory and motor block and duration of pain relief were recorded.

RESULT

Analysis revealed that Ropivacaine provided fast onset of action and better quality of anaesthesia and analgesia than bupivacaine and levobupivacaine when used in axillary brachial plexus blockade. There was no significant difference in duration of sensory blockade between three groups. But Ropivacaine showed lesser duration of motor blockade when compared to bupivacaine and levobupivacaine.

CONCLUSION

We conclude that 0.5% 30ml of ropivacaine in axillary brachial plexus block is a safe dose, allowing practitioner to produce a fast onset of sensory block and long duration of peripheral nerve block with excellent postoperative analgesia and stable hemodynamics. So ropivacaine is a better option for forearm surgeries in axillary brachial plexus block when compared with bupivacaine and levobupivacaine.

KEYWORDS

Axillary Block, Ropivacaine, Bupivacaine.

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INTRODUCTION

For over a century, brachial plexus anesthesia has been an indispensable tool in the anesthesiologist's armamentarium. Axillary block of the brachial plexus is a common, simple and safe anaesthetic technique for distal upper extremity surgery; often for elbow, forearm and hand surgery. Different techniques can be used to achieve block on using perivascular approach to brachial plexus.^[1,2,3] Bupivacaine, ropivacaine and levobupivacaine are commercially available intermediate-acting LAs. They have some differences in risk of cardiovascular and CNS toxicity, but they have similar anesthetic and analgesic potency.^[4,5]

Levobupivacaine is a long-acting local anaesthetic with a clinical profile closely resembling that of bupivacaine.⁽⁶⁾

It is a relatively new long-acting local anesthetic that have been developed after reports of simultaneous seizure and cardiac arrest with prolonged resuscitation after accidental intravascular injection of bupivacaine.⁽⁷⁾

The use of levobupivacaine is described for peripheral nerve blocks besides epidural, caudal and spinal anesthesia and the agent is used for all common indications in a wide range of clinical settings.^(8,9)

Regional anaesthesia is becoming increasingly popular for orthopaedic surgery as it offers several advantages over general anaesthesia and a trend towards more peripheral and selective nerve blocks exists.⁽¹⁰⁾

By this aim for upper limb surgery interscalene blocks are ideally suited for shoulder and upper arm surgery, supraclavicular nerve blocks for upper arm, elbow and radial side of forearm and the infraclavicular and axillary block are suited for hand, wrist and forearm surgery.⁽²⁾

Since then axillary block of the brachial plexus is a suitable anaesthetic technique both for orthopaedic, plastic

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Corresponding Author:

Dr. Hansraj Baghel,

BTI and Bharoli Road Tiraha,

Vishal Nagar, Bhopal-477001,

Madhya Pradesh.

E-mail: dr.hansrajbaghel@gmail.com

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and peripheral vascular surgery procedures performed distal to the elbow. Also in emergency surgery, axillary brachial plexus blocks represent more than 50% of all regional anesthesia techniques performed with mid-humeral brachial plexus block.⁽¹¹⁾

MATERIAL AND METHODS

After obtaining informed consent and approval of the institutional ethics committee, this prospective randomized study was conducted on 90 patients of ASA I and II of age group 20yrs-60yrs of either sex were admitted to Hamidia Hospital for elective upper limb surgeries.

The Patients Were Randomly Divided into three Groups

Group I (n= 30): Bupivacaine 0.5%-5mg/ml -- 30ml

Group II (n= 30): Levobupivacaine 0.5%-5mg/ml -- 30ml

Group III (n= 30): Ropivacaine 0.5%-5mg/ml --30ml

Proper preanesthetic checkup of all patients was done. All routine investigation like CBP, urine (Routine and microscopic), blood urea, blood sugar, ECG (in >40yrs) and relevant specific investigation was done.

Selection Criteria

- Patients of age group 20yrs-60yrs of ASA I and II physical status.

Exclusion Criteria

- Patient with history of cardiopulmonary, neurologic, active hepatic and renal diseases, psychiatric disorders.
- Pregnant and lactating women.
- Contraindication for brachial plexus block such as coagulation disorders, cutaneous local infection.
- Sensitive to local anaesthetic agents.
- Patients who were not willing for regional block.

INTRAOPERATIVE MONITORING

Pulse rate, blood pressure, respiratory rate, oxygen saturation, ECG, the onset and duration of sensory and motor blockade were monitored every 5 minutes up to first 30 minutes, then every 15 minutes up to 1hr. and then at hourly interval up to 6hrs, then 2 hourly up to 12 hrs. Complications and side effects of local anaesthetic were closely observed.

Monitoring Included Following Points

1. Onset of sensory and motor block.
2. Duration of sensory and motor block.
3. Need for any supplement analgesia.
4. Complications if any.

Sensory Block in the Surgical Procedure Planned Site was Tested by Using the Pinprick Test and Compared with the Same Stimulation in the Contralateral Hand

1. Normal sensitivity—0(no block).
2. Reduced sensitivity compared with the same territory in the contralateral upper limb—1(onset).
3. Analgesia or loss of the sharp sensation of the pinprick—2 (Partial).
4. Anaesthesia or loss of sensation to touch—3 (Complete).

Motor Block was Assessed According to the Following Scale

1. No block—0.

2. Decreased movement with loss of strength—1 (Onset).
3. Decreased movement with inability to perform movement against resistance—2 (Partial).
4. Paralysis—3 (Complete).

Patient were considered ready for surgery when score reached 2 (Partial sensory and motor). Time to Onset of sensory block (Minute): Time between the end of injection and the total abolition of the pinprick response and complete paralysis in all of nerve distributions. Time to onset of motor block (Minute): Time to reach score of 1. First analgesic requirement time (Minute): Time interval between block placement and patients, first analgesic request.

According to need for supplementary intravenous analgesia, the quality of nerve block will be evaluated as follows

- Satisfactory nerve block - No supplemental analgesia required to complete surgery.
- Unsatisfactory nerve block - Fentanyl supplementation required to complete surgery.
- Failed nerve block - TIVA or GA required to complete surgery.

Postoperative Observations

- At the end of surgery, the residual effects and duration of surgery were noted after shifting to the ward. Patient was visited for the assessment of postoperative analgesia, any complications and for monitoring of vital parameters at defined time interval.
- Postoperative analgesia assessed on 10 point of visual analogue scale.
- Visual analogue scale,
0 = No pain
10 = Worst pain
- Duration of postoperative analgesia = Time from onset of sensory blockade to time when patient VAS score was >5.

ASSESSMENT OF COMPLICATIONS AND SIDE EFFECTS

A careful watch was kept for the complication such as,

- Respiratory system-Respiration insufficiency.
- Cardiovascular system-Bradycardia and hypotension.
- Central nervous system-Headache, convulsion.
- Gastrointestinal system-Nausea and vomiting.
- Local complications-Hematomas.
- Allergic complications-Pruritis, itching etc.

The statistical significant difference among the groups was assessed by the use of one way ANOVA test, Z-test and Chi-square test. Differences were considered significant at $p < 0.05$.

RESULT AND ANALYSIS

In this study, we observed that most of the patients are between the age group of 20-30 years and male in all three groups. (Table 1 and 2). Duration of most of the surgeries is almost same. Group I-87 min, group II-78.2 min and in group III-74.2 min. (Table 3) The onset time of sensory block in group I-16.6 min, group II-15.6 min and group III-13.7 min (I>II>III). The duration of sensory block in group I-655.5 min, group II-614 min and in group III-631.5 min (I>III>II). It was found statistically significant (p value < 0.05). (Table 4A, 4B and 4C).

The onset time of motor block in group I -12.6 min, group II-11.6 min and group III -10.3 min (I>II>III). The duration of

motor block in group I-636.2 min, group II-595.7 min and in group III-560 min (I>II>III). It was found statistically significant (p value<0.05). (Table 5A, 5B and 5C).

Duration of pain relief in group I-654.8 min, group II-614.7 min and group III-631.5 min (I>III>II). It was found statistically significant (p value<0.05). (Table 6A and 6B) Mostly patients required a single dose of analgesic in 24 hr in all groups. (Table-7) No complication occurs in all three groups. (Table-8) Pulse rate, systolic blood pressure and diastolic blood pressure are almost same in all three groups. Statistically insignificant (p value >0.05). (Table 9, 10 and 11).

DISCUSSION

Importance of regional anaesthesia has increased in recent years. Regional anaesthesia for central neural blockade as well as blockade of peripheral nerves and plexus has become a vital part of present clinical practice of anesthesiologist. However, toxicity issues have tarnished the history of regional anaesthesia and although great improvements have been made.

Besides being well tolerated and safe, an ideal regional anesthetic agent should have short time of onset and lead to profound sensory and motor blockade of sufficient duration adequate for the indication or procedure.

In our study we used 0.5% of ropivacaine, 0.5% of levobupivacaine and 0.5% bupivacaine for brachial plexus blockade.

Our study was in accordance with Hickey R, Hoffman J, S Ramanuthy (1991).^[12] Our study was also in accordance with McGlade DP, Kalokas, Mooney PH, Chambey D (1998).^[13] and Klein SM, Greengrass RA, Grant SA, et al. (2001).^[14]

In our study, we used 30ml of drug volume for all the three groups. Our study was in accordance with Klein SM, Greengrass RA, Grant SA (2001).^[14] used 30ml of 0.75% and 0.5% ropivacaine and 0.5% bupivacaine for comparison in interscalene brachial plexus block.

In our study, the mean time of onset of sensory blockade was 16.6 mins in-group I, for group II mean onset time of sensory blockade was 15.6 mins and for group III it was 13.7 and time of onset of motor blockade for group I was 12.6±1.8 mins, for group II it was 11.6 and for group III it was 10.3±1.6 mins.

Our study was in accordance with Hickey R, Condido KD, Ramamurthy S (1990).^[15] compared 0.5% ropivacaine with and without epinephrine in conc of 1:200,000 in subclavian perivascular brachial plexus block for upper extremity surgeries found rapid initial onset of sensory and motor block (a mean of less than 4 min for analgesia). They found that the addition of epinephrine did not significantly affect the onset of sensory or motor block.

Our study was also in accordance with Casati A, Fanelli G, Cappellari G (1999).^[16] Nagia Mohammed Abd El Morti, Zeinab Bayoumy Youssef, Soaad Said Abd El Aal (2006).^[17] and Bertini L, Tagariello V, Mancini S, Ciaschi A, Posteraro CM (1999).^[18]

In our study, the mean duration of sensory and motor blockade of group I were 655.5 mins and 636.2 mins, that of group II were 614.7 mins and 595.7 mins and that of group III were 631.5 min and 560.5 min and P value for duration of sensory block was >0.05 and not statistically significant, but for duration of motor block P value was <0.05 which was statistically significant.

Our study was similar with Raeder JC (1999).^[19] also observed that there was no difference in duration of blockade

(9-11 hours) when ropivacaine 7.5% and bupivacaine 0.5% used for axillary brachial blockade.

Our study was also in accordance with Hickey R, Hoffman J, S Ramamurthy (1991).^[12] and Klein SM, Greengrass RA, Grant SA (2001).^[14]

In our study, the mean duration of analgesia was 654.8±37.6 mins in group I, 614.7±33.6 in group II and 631.5±32.7 mins in group III and P value was >0.05 and not significant statistically.

Our study was similar with Casati A, Albertin (2000).^[19] studied 0.5% ropivacaine and 0.5% bupivacaine for interscalene brachial plexus block and observed duration of analgesia 11±5 hrs after 0.5% ropivacaine and 10.9±3.9 hrs after 0.5% bupivacaine.

Our study was also in accordance with Hickey R, Candido KD (1990).^[15] Hickey R, Hoffman J, Ramamurthy 1991.^[12] and Casati A, Fanelli G, Cappelleri (1999).^[16]

In our study mean heart rate, systolic blood pressure, SPO2 and respiratory rate all remained within the normal limit after the block in all the three groups and were not significant statistically (p>0.05).

Our study was similar with McGlade DP (1998).^[13] observed no significant changes in vital parameter when studied 0.5% ropivacaine and 0.5% bupivacaine for axillary brachial block.

Our study was also in accordance with Hickey R, Candido KD (1990).^[15]

Hickey R, S Ramamurthy (1991).^[12] and Casati A, Albertin A (2000).^[20]

In our study, no complication occurs in all three groups. Our study was similar with Hickey R, Hoffman J, S Ramamurthy (1991).^[12] Raeder JC (1999).^[19] and Eroglu A, Uzunlar H (2004).^[21]

Thus, in our study most of the observations were in accordance with various studies conducted in the past and mentioned above. In our study onset of action of block with ropivacaine was faster than that of bupivacaine and levobupivacaine and was statistically significant. The duration of motor blockade with ropivacaine was less than that of bupivacaine and levobupivacaine and was statistically significant.

CONCLUSION

We conclude that 0.5%, 30ml of ropivacaine in axillary brachial plexus block is a safe dose, allowing practitioner to produce a fast onset of sensory block and long duration of peripheral nerve block with excellent postoperative analgesia and stable hemodynamics. So ropivacaine is a better option for forearm surgeries in axillary brachial plexus block when compared with bupivacaine and levobupivacaine.

Age in Years	Groups			Total
	I	II	III	
20-30	17	14	16	47
31-40	10	10	9	29
41-50	3	5	3	11
51-60	0	1	2	3
Total	30	30	30	90

Table 1: Showing Demographic Profile of Patients in Three Groups (Age wise Distribution of Cases)

SEX	Groups			Total
	I	II	III	
Female	5 (16.7%)	7 (23.3%)	7 (23.3%)	19
Male	25 (83.3%)	23 (76.7%)	23 (76.7%)	71
Total	30	30	30	90

Table 2: Demographic Profile of Patients (Sex wise Distribution of Cases)

	GROUP I		GROUP II		GROUP III	
	Mean	±SD	Mean	±SD	Mean	±SD
Duration of Surgery (Min)	87.0	31.7	78.2	33.9	74.2	25.0

Table 3: Showing Time Duration of Surgery (Min) Among Three Groups

	I		II		III	
	Mean	±SD	Mean	±SD	Mean	±SD
Sensory Block, Onset (Min)	16.6	1.5	15.6	1.6	13.7	1.7
Sensory Block, Duration (Min)	655.5	36.4	614.7	33.6	631.5	32.7

Table 4 (A): Showing Comparison of Sensory Blockade (Min) in Three Groups

Table showing mean ±SD of onset and duration of sensory blockade. Onset time was 16.6±1.5 min in Group I, 15.6±1.6 min in Group II and 13.7±1.7 min in Group III. Duration of sensory blockade is 655.5±36.4 min in Group I, 614.7±33.6 min in Group II and 631.5±32.7 min in Group III.

Comparison between Groups	P value	Significance
I and II	0.45	Significant
II and III	<0.001	Highly significant
I and III	<0.001	Highly significant

Table 4 (B): Sensory Block, Onset (Min) Anova [F=26.09]

Table showing intergroup analysis of sensory block onset (P value) in three groups. It was found to be significant (p<0.05) between three groups.

Comparison between Groups	P value	Significance
I and II	< 0.001	Significant
II and III	0.18	Not significant
I and III	0.024	Significant

Table 4 (C): Sensory Block, Duration (Min) Anova [F=10.7]

Table showing intergroup analysis of sensory block duration (P value) in three groups.

It was found to be significant (p<0.05) between groups I and II and groups I and III, but it was insignificant (p>0.05) between groups II and III.

	GROUP I		GROUP II		GROUP III	
	Mean	±SD	Mean	±SD	Mean	±SD
Motor Block	12.6	1.8	11.6	1.8	10.3	1.6

Onset (Min)						
Motor Block Duration (Min)	636.2	39.5	595.7	32.6	560.5	39.8

Table 5 (A): Showing Comparison of Motor Blockade (Min) Among Three Groups

Table showing mean ±SD of onset and duration of motor blockade.

The onset of motor block was 12.6±1.8 min in Group I, 11.6±1.8 min in Group II, and 10.3±1.6 min in Group III. The duration of motor blockade (Mean ±SD) was found to be 636.2±39.5 min in Group I, 595.7±32.6 min in Group II and 560.5±39.8 min in Group III.

Comparison between Groups	P value	Significance
I and II	0.065	Not significant
II and III	0.014	Significant
I and III	<0.001	Highly significant

Table 5 (B): Motor Block, Onset (Min) Anova [F=13.7]

Table showing intergroup analysis of motor block onset (P value) among three groups.

It was found to be significant (p<0.05) between groups II and III and groups I and III, but it was insignificant (p>0.05) between groups I and II.

Comparison between Groups	P value	Significance
I and II	< 0.001	Highly significant
II and III	0.001	Significant
I and III	<0.001	Highly significant

Table 5 (C): Motor Block, Duration (Min) Anova [F=30.7]

Table showing intergroup analysis of motor block duration (P value) between three groups. It was found to be significant (p<0.05) between three groups.

	GROUP I		GROUP II		GROUP III	
	Mean	±SD	Mean	±SD	Mean	±SD
Duration of Pain Relief [Min]	654.8	37.6	614.7	33.6	631.5	32.7

Table 6 (A): Showing Duration of Pain Relief (Min)

Table showing mean ± SD of duration of pain relief among three groups. It was 654.8±37.6 min in group I, 614.7±33.6 min in group II and 631.5±32.7 min in group III.

Comparison between Groups	P value	Significance
I and II	< 0.001	Highly significant
II and III	0.19	Not significant
I and III	0.032	Significant

Table 6 (B): Duration of Pain Relief Minutes Anova [F=10.1]

Table showing intergroup analysis of duration of pain relief (P value) between three groups. It was found to be significant between groups I and II and groups I and III, but it was insignificant between groups II and III.

No. of Analgesic doses required in first 24 hrs.	GROUP I	GROUP II	GROUP III	Total
0	8	7	5	20
1	18	19	20	57
2	4	4	5	13
Total	30	30	30	90

Table 7: Showing no. of Analgesic Doses required in First 24 Hours

Complications	GROUP I	GROUP II	GROUP III	Total
NIL	28	27	28	83
Nausea	1	2	2	5
Vomiting	1	1	0	2
Total	30	30	30	90

Table 8: Showing Complications in Three Groups

Pulse Rate Mean	GROUP I		GROUP II		GROUP III	
	Mean	±SD	Mean	±SD	Mean	±SD
Baseline	83.50	12.328	82.90	11.096	81.03	9.782
5 Min	82.40	12.588	82.47	10.605	81.00	8.971
10 Min	82.20	11.294	82.60	9.673	81.33	8.539
15 Min	80.60	9.974	82.20	10.162	81.47	8.468
30 Min	81.20	9.932	81.67	9.338	81.10	8.248
45 Min	79.80	9.253	81.80	10.284	80.30	8.595
60 Min	79.13	8.366	81.53	10.044	79.87	8.220
90 Min	79.20	7.622	80.73	9.833	80.20	8.193
120 Min	79.00	7.944	80.30	9.531	79.67	8.438
6 Hrs.	78.30	7.042	80.50	9.479	80.20	7.832
12 Hrs.	80.20	7.494	80.70	10.120	80.07	7.728
18 Hrs.	79.93	7.638	81.53	9.794	80.53	7.736
24 Hrs.	81.37	8.215	81.37	8.798	81.00	7.786

Table 9: Showing Statistical Analysis of Pulse Rate (Per/Min) Among Three Groups

Table showing pulse rate (Mean±SD) at different intervals in all the three groups.

SBP	GROUP I		GROUP II		GROUP III	
	Mean	±SD	Mean	±SD	Mean	±SD
Baseline	121.93	8.391	121.80	9.178	122.70	7.944
5 Min	121.57	8.850	121.80	9.415	122.53	8.386
10 Min	123.10	9.061	122.83	7.729	122.73	8.128
15 min	125.9	181.989	123.13	6.882	122.47	8.046
30 Min	118.13	9.336	122.10	7.097	122.33	7.503
45 Min	117.77	11.584	121.13	7.477	122.60	7.686
60 Min	115.53	12.065	120.73	8.060	122.00	7.316
90 Min	115.53	11.705	119.70	7.706	121.27	5.789
120 Min	115.50	10.951	119.00	7.856	121.43	5.975
6 Hrs.	115.60	10.095	118.77	8.557	118.53	18.390
12 Hrs.	116.93	10.709	119.20	8.576	122.40	6.775
18 Hrs.	117.83	9.728	118.20	8.277	121.80	7.092
24 Hrs.	119.33	9.817	119.53	8.233	122.47	6.842

Table 10: Showing Statistical Analysis of Systolic Blood Pressure (Mm of Hg) Among Three Groups

Table showing Systolic blood pressure (Mean ±SD) among all three groups.

DBP	GROUP I		GROUP II		GROUP III	
	Mean	±SD	Mean	±SD	Mean	±SD
Baseline	74.70	8.086	75.37	8.969	76.73	8.513
5 Min	72.53	8.866	75.73	9.864	74.67	7.671
10 Min	72.60	9.758	76.17	9.952	74.67	8.652
15 Min	71.33	9.998	75.37	10.836	74.00	8.103
30 Min	72.13	10.075	73.87	10.569	74.73	8.982
45 Min	72.53	10.451	73.50	9.623	73.53	8.815
60 Min	72.87	10.030	72.73	9.762	75.00	8.250
90 Min	72.33	9.308	72.90	9.571	74.67	8.360
120 Min	72.33	8.790	72.80	9.535	74.73	8.060
6 Hrs.	72.20	8.244	73.20	9.579	74.27	8.233
12 Hrs.	71.47	7.682	73.20	8.560	74.00	7.861
18 Hrs.	71.67	9.470	72.73	8.461	74.40	8.443
24 Hrs.	72.87	9.138	73.80	9.675	74.80	8.130

Table 11: Showing Statistical Analysis of Diastolic Blood Pressure (Mm of Hg) Among Three Groups

Table showing diastolic blood pressure (mmHg) (Mean±SD) in three groups.

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