EFFICACY OF LEVOBUPIVACAINE AND BUPIVACAINE IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK FOR FOREARM ORTHOPAEDIC SURGERIES AN OBSERVATIONAL STUDY

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ABSTRACT

BACKGROUND

Surgeries of upper limb are usually done under brachial plexus blockade of which supraclavicular approach is commonly used. Bupivacaine, lignocaine, and ropivacaine are commonly used local anaesthetic agents.

METHODS

The present study is a prospective observational study to evaluate the onset of sensory blockade, quality of motor blockade, duration of analgesia, and intraoperative side effects if any of bupivacaine and levobupivacaine in supraclavicular brachial plexus blockade. Study was conducted in ASA grade 1 and 2 patients posted for elective forearm orthopaedic surgeries. A sample size of 60 patients were randomly allocated into two groups. Supraclavicular brachial plexus block was given using a peripheral nerve stimulator.

RESULTS

They received 30 mL of 0.375% local anaesthetic. One group received bupivacaine and another group levobupivacaine. Onset of block, quality of motor block, duration of analgesia, and side effects of drugs were recorded and studied. Statistical analysis was done. Test of significance such as t test for qualitative variables and chi-square test for quantitative variables were done. We observed that the onset time, duration of analgesia, and quality of motor blockade of levobupivacaine were not significantly different from those of bupivacaine.

CONCLUSION

Based on this study, levobupivacaine can be recommended over bupivacaine for brachial plexus blocks because of its similar pharmacodynamics profile and decreased cardiotoxicity.

KEYWORDS

Supraclavicular brachial plexus block, Bupivacaine, Levobupivacaine, Forearm orthopaedic surgeries.

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INTRODUCTION: Upper limb orthopaedic surgeries are usually done under brachial plexus block. Lignocaine, bupivacaine and ropivacaine are commenly used local anaesthetics for block. Lignocaine has short duration of action, although onset is faster. Bupivacaine, a racemic local anaesthetic exists as an equal mixture of its components, the S and R enantiomers. Bupivacaine exhibits high cardio toxicity due to its ability to depress the intracardiac conduction velocity and cardiac contractility[(1)] mostly due to it's R – enantiomer.[(2)] It binds specifically to myocardial sodium channels showing a 'fast in, slow out' response. It decreases peripheral vascular resistance and myocardial contractility causing hypotension, bradycardia, arrhythmias, AV blocks, and cardiovascular collapse.[(3)] It has a biphasic effect on CNS. With increasing dose, depression of both inhibitory and facilitatory pathways occur causing symptoms like drowsiness, disorientation, slurred speech, skeletal muscle twitching, and coma. These events stimulated the search for safer local anaesthetics and resulted in the development of local anaesthetic containing only S (-) enantiomer. Recently, the single S (-) enantiomer of bupivacaine has been put on the market as levobupivacaine, which has a lower cardio toxicity. Lower toxic profile of levobupivacaine makes it an attractive choice for brachial plexus block. The motor and sensory blockade of levobupivacaine in brachial plexus block is comparable to that of bupivacaine. Levobupivacaine is an amino-amide local anaesthetic drug belonging to the family of n-alkyl substituted pipecoloxylidide. The levorotatory isomers were shown to have a safer pharmacological profile[(4,5)] with less cardiac and neurotoxic adverse effects.[(6,7)]

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The decreased toxicity of levobupivacaine is attributed to its faster protein-binding effect.[8] Bupivacaine has the advantage of providing a longer duration of action and a favourable sensory to motor neural block ratio. Large volume of local anaesthetic is needed for brachial plexus block compared to central neuraxial block. Brachial plexus blockade can set a potential place for absorption of local anaesthetics and the development of systemic toxicity.[9] Compared to ropivacaine, levobupivacaine provides a significantly longer duration of analgesia.[10] The long duration of sensory block associated with good analgesia and less toxicity of levobupivacaine makes it a better choice for upper extremity blocks.[11]

AIM OF STUDY: To compare the onset of sensory blockade, quality of motor blockade, the duration of analgesia, intraoperative side effects if any in supraclavicular brachial plexus blockade using 0.375% bupivacaine and levobupivacaine for forearm orthopaedic surgeries in adults.

MATERIALS AND METHODS: The study was done from 2011-2014 under the Department of Anaesthesiology, Govt. T. D. Medical College, Alappuzha, Kerala, after getting approval from institutional research committee and ethical committee.

Inclusion Criteria:

- Elective orthopaedic surgeries of forearm.
- Age group between 18-55 years.
- ASA grade I and II patients.
- Weight of the patients between 50 - 70 kg.

Exclusion Criteria:

- Patient refusal to regional blockade.
- History of drug allergy to local anaesthetics.
- Patients with coagulation disorders, neurological disorders, psychiatric illness.

Sample Size: A sample size of 60 patients were allocated into two study groups of 30 each, named A and B.

Sample Size = $(Z_\alpha + Z_{1-\beta})^2 x[(SD_1^2+SD_2^{2)}/(n1-n_2)^2]$

Design of Study: Prospective observational study.

After obtaining permission from institutional ethics committee, consent of patients were taken and they were randomly divided into two study groups, named A and B.

All patients were premedicated orally with tab. ranitidine 150 mg, tab. ondansetron 4 mg, tab. alprazolam 0.25 mg on preoperative night and at 6 a.m. on the day of surgery. On arrival in the inducing room, standard monitors as SpO2, ECG, NIBP were attached. IV line started in nonoperative arm with normal saline. Baseline pulse rate and BP were recorded.

Positioning: The patient was placed in supine position on a flat table top with head turned away from the side to be blocked. Wedge was placed on the back at the interscapular region. Arm to be anaesthetised was abducted and placed alongside the body. The respective supraclavicular area was painted with povidone-iodine and draped.

Technique: Midpoint of the clavicle was identified and marked. Subclavian artery palpated. Wheal was raised 1.5-2 cm posterior to the midpoint of clavicle just lateral to subclavian artery using local anaesthetic. Supraclavicular brachial plexus block was given using peripheral nerve stimulator. The positive lead of the stimulator attached to the patient and the negative terminal of the stimulator to the needle. An initial current of 1 to 1.5 mA was set. The site that triggered forearm muscular response to a stimulus equal to or less than 0.4 mA was identified. Proposed drug was injected after aspiration test to prevent intravascular injection. Group A received 30 mL of 0.375% of inj. bupivacaine and group B received 30 mL of 0.375% of levobupivacaine.

Onset of sensory block, quality of motor block, duration of analgesia, and intraoperative side effects if any were recorded at 3 minutes interval for the first 10 minutes, thereafter, every 5 minutes till the end of surgery.

Assessment:

Onset of Sensory Blockade: Onset of sensory blockade was determined as time from the end of supraclavicular injection to onset of analgesia in the dermatome C6, 7, 8, and T1.

Sensory block was evaluated initially using spirit swab and then by pinprick method in the dermatome C6, 7, 8, and T1 at every 3 minutes till analgesia obtained or up to 30 minutes from the administration of the drug.

Quality of Motor Blockade: Motor block was assessed by Modified Bromage Scale.

Grade	Criteria	Motor Block
0	Able to raise the extended arm to 90^0 for a full 2 sec.	Nil
1	Able to flex the elbow and move fingers, but unable to raise the extended arm	Partial
2	Unable to flex the elbow, but can move fingers.	Almost complete
3	Unable to move the arm, elbow, or fingers.	Complete

After establishment of grade 3 blockade, sedation was supplemented with titrated intravenous boluses of midazolam 1 mg till patient sleeps.

Failure of blockade would be declared if the required sensory or motor blockade cannot be achieved up to 30 minutes after the administration of the local anaesthetic. These patients would be excluded from the study and general anaesthesia was given.

Duration of Analgesia: Postoperative pain evaluated by visual analogue scale. In this scale, 0 corresponds to no pain and 100 corresponds to the worst pain.

Duration of analgesia was the time taken from the administration of the study drug to the time when the patient complained of pain of >50 in visual analogue scale.

Pain was managed by inj. tramadol 50 mg intramuscularly.

Intraoperative Side Effects: The most common intraoperative complications monitored were Hypotension, Bradycardia, Nausea, Vomiting, Pruritus, Headache, Tinnitus, Dizziness, and Convulsions.

STATISTICAL ANALYSIS: Qualitative variables summarised using proportions with 95% C. I. Quantitative variables summarised using mean with standard deviation. Test of significance such as t test for qualitative variables and chi-square test for quantitative variables were done.

RESULTS: Our results observed that the onset time, duration of analgesia, and quality of motor blockade of levobupivacaine were not significantly different from those of bupivacaine when supraclavicular block was performed with 30 mL of local anaesthetic.

Two of our patients developed hypotension in bupivacaine group, which was treated with Mephentermine. One patient from each group developed nausea.

None of our patients developed side effects like bradycardia, vomiting, or convulsion.

Statistical Interpretation: Using statistical analysis, there is no significant difference between the groups with respect to age distribution and hence they were comparable. (Table 1).

Age	Bupivacaine		Levobupivacaine	
	Count	Percent	Count	Percent
<30	12	40.0	7	23.3
30 - 39	4	13.3	8	26.7
40 - 49	11	36.7	7	23.3
50 - 55	3	10.0	8	26.7
Mean±SD	35.4±11.3		39.1±11.2	

Table 1: Comparison Based on Age

t= 1.28, p= 0.206.

Chi-square analysis yielded a p value of >0.05, which shows that there is no significant difference between the groups with regard to gender. (Table2).

Sex	Bupivacaine		Levobupivacaine		χ^2	p
	Count	Percent	Count	Percent		
Male	22	73.3	19	63.3	0.69	0.405
Female	8	26.7	11	36.7		

Table 2: Distribution According to Sex

Group	Mean	SD	N	t	p
Bupivacaine	63.5	3.3	30	0.12	0.907
Levobupivacaine	63.6	3.3	30		

Table 3: Comparison of Weight Based on Group

There is no significant difference between the groups with respect to weight distribution and hence they were comparable. (Table 3).

Group	Mean	SD	N	t	p
Bupivacaine	18.1	3.7	30	0.73	0.466
Levobupivacaine	17.4	3.6	30		

Table 4: Comparison According to Time of Onset of Sensory Blockade

The mean onset of sensory block (table 4) in bupivacaine group was 18.1 mins with SD of 3.7 and that of levobupivacaine group was 17.4 mins with SD of 3.6. Statistical analysis using independent t-test revealed a p value of >0.05, which is not significant.

Quality of motor blockade	Bupivacaine		Levobupivacaine		χ^2	p
	Count	Percent	Count	Percent		
Grade II	9	30.0	5	16.7	1.49	0.222
Grade III	21	70.0	25	83.3		

Table 5: Distribution According to Quality of Motor Blockade

When quality of motor block was compared, both groups produced an excellent result. (Table 5) in group A 70% of the patients showed grade 3 block (Complete block) whereas in group B it was 83.3%. Statistical analysis using chi-square test yielded a p value of >0.05, which was not significant statistically.

Group	Mean	SD	N	t	p
Bupivacaine	625.3	41.9	30	0.22	0.830
Levobupivacaine	628.2	58.4	30		

Table 6: Comparison of Duration of Analgesia

Hypotension	Bupivacaine		Levobupivacaine		p#
	Count	Percent	Count	Percent	
Absent	28	93.3	30	100.0	0.490
Present	2	6.7	0	0.0	

Table 7: Distribution According to Hypotension

#: Fisher's Exact Test.

Nausea	Bupivacaine		Levobupivacaine		p#
	Count	Percent	Count	Percent	
Absent	29	96.7	29	96.7	1.000
Present	1	3.3	1	3.3	

Table 8: Distribution According to Nausea Based on Group

#: Fisher's Exact Test.

Mean duration of analgesia in bupivacaine group was 625.3 mins with SD of 41.9 (table 6). In the levobupivacaine group, the mean was 628.2 mins with SD of 58.4. Statistical analysis using independent t-test revealed a p value of >0.05, which is not significant. So, there is no significant difference between the groups with respect to duration of analgesia.

Two of our patients developed hypotension in bupivacaine group, which was treated with Mephentermine. One patient from each group developed nausea.

None of our patients developed side effects like bradycardia, vomiting, or convulsion.

DISCUSSION: In this study, ASA grade 1 and 2 patients between the age group of 18 and 55 years were included so that patient related factors played minimum role. Mean age of group A (Bupivacaine group) was 35.4±11.3 and that of group B (Levobupivacaine group) was 39.1±11.2.

Majority of patients were males in both groups. 73.3 in group A and 63.3 in group B.

Cox et al[12] evaluated the dose of 0.4 mg/kg-1 of 0.25% and 0.5% levobupivacaine and 0.5% racemic bupivacaine in patients undergoing elective hand surgeries and they did not observe statistically significant differences in the latency of the sensorial blockade between the groups.

In the study of Lisanatti et al[13] on axillary brachial plexus block with 45 mL of local anaesthetic (0.5% levobupivacaine, 0.5% ropivacaine, or 0.5% racemic bupivacaine) without epinephrine, the authors observed that the latency of the sensorial blockade was similar in the three groups. In our study, onset of sensory block was comparable in both the groups. Mean onset time was 18.1±3.7 minutes in group A and 17.4±3.6 minutes in group B.

In our study, the duration of analgesia obtained in group A was 625.3 minutes with standard deviation (SD) of 41.9 and that of group B was 628.2 minutes with SD 58.4. The data was analysed using students t-test and yield a P value of >0.05, which implies that the duration of analgesia for both groups is comparable.

Cox et al[12] found 68% of patients with a "satisfactory block" after a supraclavicular brachial plexus block in a surgical setting.

In the study of Liisanatti et al[13] on axillary brachial plexus block with 45 mL of local anaesthetic (0.5% levobupivacaine, 0.5% ropivacaine, or 0.5% racemic bupivacaine) without epinephrine, the authors observed similar latency of the motor blockade in the three studied groups, but they analysed the motor blockade of the shoulder and hand separately and observed that the degree of the motor blockade in the shoulder was greater in the ropivacaine group followed by bupivacaine and levobupivacaine. The motor blockade in the hand did not show statistically significant differences.

The present study used the supraclavicular technique and there was no differences in quality of analgesia and degree of motor block.

Clinical comparisons of 0.5% and 0.375% levobupivacaine for ultrasound-guided axillary brachial plexus block with nerve stimulation was done by WonkyoKim, YounJin Kim et al.[14]

They showed that 0.375% levobupivacaine produced adequate anaesthesia for brachial plexus block using US guidance with nerve stimulation without any clinically significant differences compared to 0.5% levobupivacaine.

We used 0.375% levobupivacaine for our study.

Launo et al [15] compared 0.125% levobupivacaine and 0.2% ropivacaine in combination with fentanyl 2 µg/mL for thoracic epidural analgesia after aortic surgery and reported no differences in quality of analgesia and degree of motor block.

In our study, the quality of motor block as per modified Bromage scale grading in group A, 70% showed grade 3 and 30% grade 2 block; in group B, 83.3% showed grade 3 and 16.7% grade 2 block. In the present study, statistically

significant differences in motor blockade were not observed between both groups when compared by student t-test.

As we compared the intraoperative side effects in group A and group B, two patients presented with hypotension and one patient complained of nausea in group A whereas in group B one patient complained of nausea, which was statistically insignificant.

CONCLUSION: The onset of sensory block was comparable in both groups. Duration of analgesia in both groups was near equal. Quality of motor block was also comparable as majority of both groups showed grade 3 blockade (Complete block).

No serious side effects were observed in either group except for 2 patients in group A showing signs of hypotension, which was treated with vasopressor. One in each group complained of nausea during the beginning of surgery. Heart rate, noninvasive blood pressure, and peripheral oxygen saturation showed no statistically significant inter- or intra-group differences during the entire study period. In the 60 patients involved in this clinical trial, no signs of cardiac or CNS toxicity were observed.

Our results observed that the onset time, duration of analgesia, and quality of motor blockade of levobupivacaine were not significantly different from those of bupivacaine when supraclavicular block was performed with 30 mL of local anaesthetic.

Studies have shown that bupivacaine produces disturbing reports of sudden cardiac arrest without prodromal central nervous system (CNS) symptoms.[16]

Based on our study, levobupivacaine can be recommended instead of bupivacaine for supraclavicular brachial plexus block because of its similar pharmacodynamic profile and reported decreased toxicity.

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