A COMPARATIVE STUDY OF BUPIVACAINE 0.5%, ROPIVACAINE 0.5% AND LEVOBUPIVACAINE 0.5% IN INTERSCALENE BRACHIAL PLEXUS BLOCK FOR UPPER LIMB SURGERIES IN ADULTS

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ABSTRACT

BACKGROUND

The interscalene approach to the brachial plexus is best suited to surgeries of the shoulder or upper arm surgeries. It provides safe, effective and low cost anaesthesia with excellent post-operative analgesia.

Aim of the current study was to attempt to compare Bupivacaine 0.5%, Ropivacaine 0.5% and Levobupivacaine 0.5% in interscalene brachial plexus block with respect to Onset time and Duration of Sensory and Motor block.

MATERIALS AND METHODS

Ninety patients aged between 18 yrs. and 60 yrs. of physical status ASA grade I and ASA grade II undergoing elective upper limb surgeries lasting more than 30 minutes were included in the study.

- Each patient was randomly allocated to one of the three groups of 30 patients each.
- Bupivacaine group received 30 mL Bupivacaine 0.5% (5 mg/mL).
- Ropivacaine group received 30 mL Ropivacaine 0.5% (5 mg/mL).
- Levobupivacaine group received 30 mL Levobupivacaine 0.5% (5 mg/mL).

RESULTS

In our study, we observed that onset time and duration of sensory and motor block were similar in the three groups. The mean sensory onset time in Bupivacaine group was 8.70 ± 2.68 minutes, 7.43 ± 2.69 minutes in Ropivacaine group and 8.77 ± 3.58 minutes in Levobupivacaine group, which was statistically insignificant ($p=0.161$). The mean motor onset time in Bupivacaine group was 13.33 ± 4.23 minutes, 11.23 ± 3.46 minutes in Ropivacaine group and 12.77 ± 5.06 minutes in Levobupivacaine group, which again was statistically insignificant ($p=0.153$). The duration of sensory block for Bupivacaine group was 490.00 ± 127.12 minutes, 512.00 ± 107.72 minutes for Ropivacaine group and 540.00 ± 118.96 minutes for Levobupivacaine group. This was statistically insignificant ($p=0.265$). The duration of motor block for Bupivacaine group was 524.00 ± 133.64 minutes, 548.00 ± 104.20 minutes for Ropivacaine group and 574.00 ± 112.18 minutes for Levobupivacaine group. This too was statistically insignificant ($p=0.261$). There were no significant differences between the study groups with respect to changes in heart rate, systolic blood pressure, diastolic blood pressure and mean arterial blood pressure perioperatively.

CONCLUSION

It is concluded that there is no difference seen with respect to the onset and duration of sensory and motor block between equal concentration and volume of Racemic Bupivacaine and the newer long-acting local anaesthetics- Ropivacaine and Levobupivacaine in Interscalene Brachial Plexus Block.

KEYWORDS

Brachial Plexus Block; Bupivacaine; Ropivacaine; Levobupivacaine.

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BACKGROUND

Peripheral nerve blocks have become important in clinical practice because of their role in post-operative pain relief, shortening of patient recovery time & avoiding risks and adverse effects of General anaesthesia. Hence, peripheral nerve blockade is now a well-accepted concept for comprehensive anaesthetic care.

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Brachial plexus blocks provide a useful alternative to general anaesthesia for upper limb surgeries. They achieve near ideal operating conditions by producing complete muscular relaxation, maintaining stable intra-operative haemodynamic condition and avoidance of the risks and side effects of general anaesthesia, especially in patients with underlying medical conditions in whom general anaesthesia may place the patient at significant risk.

The other advantages of brachial plexus block over general anaesthesia are:

- Early ambulation after surgery.
- Decreased incidence of Post-operative nausea and vomiting.
- Ideal operating conditions can be obtained to meet surgical requirements.
- Decreases surgical and non-surgical intra-operative time.

- Decreases post-operative pain.
- Shorter duration of stay in the PACU.
- Allows aggressive physiotherapy and thus improve shoulder mobility in the immediate post-operative period.
- Patient acceptance.

The interscalene approach to the brachial plexus is best suited to surgery of the shoulder or upper arm surgery where a block of the lower cervical plexus is also desirable.¹

Local anaesthetics administered as regional nerve blocks provide postoperative pain relief by blocking signal transmission to dorsal horn.

Bupivacaine is a long acting local anaesthetic. Due to its long duration of action and combined with its high quality sensory anaesthesia relative to motor blockade it has been the most commonly used local anaesthetic for peripheral nerve blocks.

Ropivacaine and Levobupivacaine are two new long-acting local anaesthetics, whose neuronal blocking potential used in peripheral nerve blockade seems to be similar. Studies show that they have a significantly greater safety margin over bupivacaine because of lower CNS and cardiac toxicity.²

Aims

To compare the effects, safety and efficacy of Bupivacaine 0.5%, Ropivacaine 0.5% and Levobupivacaine 0.5% used for Interscalene approach to Brachial Plexus Block.

Objectives

- Onset time of sensory block.
- Onset time of motor block.
- Duration of sensory block.
- Duration of motor block.

MATERIALS AND METHODS

Method of Collection of Data

Ninety patients aged between 18 yrs. and 60 yrs. of physical status ASA grade I and ASA grade II undergoing elective upper limb surgeries lasting more than 30 minutes were included in the study. Each patient was visited pre-operatively. Complete blood count, blood grouping, blood sugar, bleeding time, clotting time, blood urea, serum creatinine, serum electrolytes (Sodium, potassium, chloride), chest X-ray, ECG were done. All patients were pre-medicated with tablet alprazolam 0.5 mg overnight and the morning of surgery.

Inclusion Criteria

- Patients aged between 18 yrs. and 60 yrs.
- Physical status ASA grade I and ASA grade II.
- Patients weighing more than 50 kg.
- Scheduled for elective shoulder and upper limb surgeries after obtaining written/informed consent from the patients.

Exclusion Criteria

- Patient's refusal.
- Known allergy to local anaesthetic agents.
- Traumatic nerve injury.
- History of respiratory disorders.
- History of neuromuscular diseases.

- History of cardiovascular diseases.
- Bleeding disorders or patient on anticoagulant therapy.
- Hepatic or Renal failure.
- Pregnant women.

Each patient was randomly allocated to one of the three groups of 30 patients each.

Bupivacaine group received 30 mL Bupivacaine 0.5% (5 mg/mL).

Ropivacaine group received 30 mL Ropivacaine 0.5% (5 mg/mL).

Levobupivacaine group received 30 mL Levobupivacaine 0.5% (5 mg/mL).

All necessary equipment and drugs needed for administration of general anaesthesia and resuscitation were kept ready in order to manage failure of block and any complications.

Procedure

Intravenous access was obtained in the limb opposite to that undergoing surgery with an intravenous cannula-18G. Standard monitors, ECG, pulse oximeter, non-invasive blood pressure, respiratory monitoring were connected and monitored continuously in all the patients and recorded at interval of 5 minutes in the first hour and every 30 minutes thereafter till the end of 2 hours.

Modified Lateral approach was used. Patient was placed in supine position with head extended and rotated to contralateral side. Arm to be anaesthetised was pronated and directed to ipsilateral knee.

Landmarks

1. Lateral border of clavicular head of sternocleidomastoid.
2. Mid-Point of clavicle.
3. External jugular vein.

Supraclavicular area was aseptically prepared and draped. We palpated immediately lateral to sternocleidomastoid for scalenus anterior muscle. Lateral to it is middle scalenus and in between is the interscalene groove. In many of the patients, EJV crosses the groove. Sniffing forcefully by patient helped in easy visualisation and palpation of the groove. The point of insertion was at the level of cricoid cartilage.

Under aseptic precautions, a 21G needle was inserted 60° to the skin and advanced in a caudal and slightly dorsal and lateral direction. With the palpating fingers pressing the interscalene groove the needle was slowly advanced until a single paraesthesia was elicited in the ipsilateral upper extremity.

In the event of bony transverse process being encountered, the needle was partially withdrawn and redirected anteriorly. Once paraesthesia was obtained, the needle was stabilised and aspiration was attempted to exclude intravascular needle placement and 30 mL of local anaesthetic was injected.

Sensory block was assessed by pinprick with 23G hypodermic needle in skin dermatomes C4-T1 once in every 2 minutes for initial 30 minutes and then every 30 minutes post-operatively till patient regained normal sensations and graded according to Visual analogue scale (VAS).

Quality of motor blockade was assessed at the same intervals and graded according to Muscle Strength Grading.

Onset time of Motor blockade- taken from the completion of injection of study drug till the patient develops motor blockade. (Muscle Strength Grade 0).

Onset time of Sensory blockade- taken from the completion of injection of study drug till the patient does not feel the pinprick. (Visual analogue scale score -0).

Duration of Motor blockade- taken from the Onset of Motor blockade till complete recovery of motor power. (Muscle Strength Grade 5).

Duration of Sensory blockade- taken from the Onset of Sensory blockade till the patient feels pinprick. (Visual analogue scale of 2).

Patients were watched for bradycardia, convulsions, restlessness, disorientation, drowsiness, nausea, vomiting & any other complications.

RESULTS

There is no statistical difference with regards to the physical characteristics, such as height and weight, between the three groups.

	Bupivacaine Group	Ropivacaine Group	Levobupivacaine Group	P Value
SOT (min.)	8.70±2.68	7.43±2.69	8.77±3.58	0.161
MOT (min.)	13.33±4.23	11.23±3.46	12.77±5.06	0.153
DOSB (min.)	490.00±127.12	512.00±107.72	540.00±118.96	0.265
DOMB (min.)	524.00±133.64	548.00±104.20	574.00±112.18	0.261
Table 1. Onset and Duration of Sensory and Motor Blockade: A Comparison Between the Three groups				

The mean onset time of sensory block in Bupivacaine group was 8.70±2.68 min., 7.43±2.69 min. in Ropivacaine group and 8.77±3.58 min. in Levobupivacaine group. The statistical analysis showed no significant difference between the three groups (p=0.161).

The mean onset time of motor block in Bupivacaine group was 13.33±4.23 min., 11.23±3.46 min. in Ropivacaine group and 12.77±5.06 min. in Levobupivacaine group. No significant statistical difference was seen between the three groups (p= 0.153).

The mean duration of sensory block in Bupivacaine group was 490.00±127.12 min., 512.00±107.72 min. in Ropivacaine group and 540.00±118.96 min. in Levobupivacaine group. There was no significant statistical difference seen between the three groups with regards to duration of sensory block (p=0.265).

The mean duration of motor block in Bupivacaine group was 524.00±133.64 min., 548.00±104.20 min. in Ropivacaine group and 574.00±112.18 min. in Levobupivacaine group. This too showed no significant statistical difference between the three groups (p=0.261).

DISCUSSION

Brachial Plexus Block for upper limb surgeries is the most common major peripheral nerve block technique. The Interscalene technique preferentially blocks the caudal nerves of the cervical plexus and cephalad nerves of the brachial plexus.³ It is commonly used for surgery of the clavicle, shoulder and upper arm.

A significant difference exists between various local anaesthetics like Lignocaine, Mepivacaine, Bupivacaine in terms of onset times, total duration and safety profile when used in Brachial Block. Ropivacaine and Levobupivacaine are newer long acting amide local anaesthetics found to be equally efficacious to Bupivacaine, but with a better safety profile owing to their varying CC/CNS ratios.²

Onset time of Sensory and Motor block

In our study, we observed that onset time of sensory block in Bupivacaine group was 8.70±2.68 minutes, 7.43±2.69 minutes in Ropivacaine group and 8.77 ± 3.58 minutes in Levobupivacaine group, which is statistically insignificant (p= 0.161).

The onset time of motor block in Bupivacaine group was 13.33±4.23 minutes, 11.23±3.46 minutes in Ropivacaine group and 12.77±5.06 minutes in Levobupivacaine group, which again is statistically insignificant (p= 0.153).

A prospective, randomised, double blind comparative study was conducted by Andrea Casati et al to assess the onset time and quality of interscalene brachial plexus block undergoing open shoulder surgery randomly allocated to receive 30 mL of 0.5 Levobupivacaine (n=25) or 0.5% Ropivacaine (n=25). The onset time of surgical block was 20 min. (10-40 min.) with Levobupivacaine and 20 min. (5-45 min.) with Ropivacaine (p=0.53). The block was also prolonged after surgery using a patient controlled interscalene analgesia with 0.125% levobupivacaine or 0.2% ropivacaine.

They concluded that 30 mL of Levobupivacaine 0.5% induces an interscalene brachial plexus anaesthesia of similar onset and intensity as the one produced by the same volume and concentration of ropivacaine.⁴

Stephen M Klein et al also observed that the onset times, in 3 groups of patients receiving 30 mL of 0.5% Bupivacaine, 0.5% Ropivacaine and 0.75% Ropivacaine under Interscalene Brachial Plexus Block, showed no difference in the time to onset to sensory and motor onset.⁵

Eroglu et al in their comparative study for Interscalene Brachial Plexus Anaesthesia found out that the mean onset time with Ropivacaine was 18±12 minutes and 21±13 minutes for Bupivacaine when used in same volume and concentration (30 mL of 0.5%).⁶

The above observations were similar to our results which prove that Bupivacaine 0.5% has a similar onset of sensory and motor blockade in comparison with Ropivacaine 0.5% and Levobupivacaine 0.5%.

Duration of Sensory Block and Motor Block

The duration of sensory block for Bupivacaine group was 490.00±127.12 minutes, 512.00±107.72 minutes for Ropivacaine group and 540.00±118.96 minutes for Levobupivacaine group. These values are statistically insignificant (p= 0.265).

The duration of motor block for Bupivacaine group was 524.00±133.64 minutes, 548.00±104.20 minutes for Ropivacaine group and 574.00±112.18 minutes for Levobupivacaine group. These values too are statistically insignificant (p= 0.261).

Stephen M Klein et al observed three groups of patients receiving 30 mL of 0.5% Bupivacaine, 0.5% Ropivacaine and 0.75% Ropivacaine under Interscalene Brachial Plexus Block⁵.

There were no differences in age, weight, gender or ASA classification among the groups. There were no differences among the three groups for time to recovery as defined by recovery of sensation in shoulder, onset of pain in shoulder and first use of pain medicine. They demonstrated a similar efficacy between equal concentrations of Ropivacaine and Bupivacaine.

Eroglu et al also found out that same volume and concentration of Bupivacaine and Ropivacaine (30 mL of 0.5%) produced similar surgical block. The pain scores, total rescue analgesic and side effects were similar between the groups.⁶

Andrea Casati et al also found out that the intensity of block produced by 30 mL of 0.5 % Levobupivacaine is similar to that produced by 30 mL of 0.5% Ropivacaine.⁴

Our study conforms to the findings of the above studies, which have stated that the duration of sensory and motor block at equal concentrations of Bupivacaine, Ropivacaine and Levobupivacaine are similar, when used for Interscalene approach to Brachial Plexus Block.

Hence, we conclude, that Bupivacaine 0.5%, Ropivacaine 0.5% and Levobupivacaine 0.5% show similar efficacy with respect to onset time and duration of sensory and motor blockade for Interscalene Brachial Plexus Block at equal volume of 30 mL each.

Changes in the Perioperative Haemodynamic Parameters

There were no significant differences between the study groups with respect to changes in heart rate, systolic blood pressure, diastolic blood pressure and mean arterial blood pressure perioperatively.

Levobupivacaine and Ropivacaine, two new long-acting local anaesthetics, have been developed as an alternative to Bupivacaine, after the evidence of its severe toxicity. Both of these agents being pure left-isomers seem to have less toxic effects on the central nervous system and on the cardiovascular system. A review by Stefanie et al supports the evidence that both Levobupivacaine and Ropivacaine have a clinical profile similar to that of racemic Bupivacaine. However, the reduced toxic potential of the two pure left isomers suggests their use in the clinical situations in which the risk of systemic toxicity related to either overdosing or unintended intravascular injection is high.²

CONCLUSIONS

On the basis of our study, we draw the conclusion that at equal volumes, Bupivacaine 0.5%, Ropivacaine 0.5% and Levobupivacaine 0.5% in Interscalene Brachial Plexus Block have-

- Similar onset of Sensory blockade.
- Similar onset of Motor blockade.
- Similar Duration of Sensory blockade.
- Similar Duration of Motor blockade.

Hence, we advocate the use of these newer long-acting local anaesthetics- Ropivacaine and Levobupivacaine in Interscalene Brachial Plexus Block, in comparison to Racemic Bupivacaine as there is no difference seen with respect to the onset and duration of sensory and motor block between the three groups and with the newer agents proven to have a higher safety index.

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