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Original Article

A Prospective, Randomized Study Comparing Bupivacaine and Levobupivacaine through Ultrasound-guided Supraclavicular Block in Patients Undergoing Elective Upper Limb Surgeries

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Abstract

Introduction: Levobupivacaine is a pure S-enantiomer of bupivacaine, and it has similar anesthetic profile with racemic bupivacaine but reduced toxic potential. We conduct the present study to evaluate and compare the intraoperative hemodynamics and onset and duration of sensory and motor blockade.

Aim: This study aims to compare ultrasound-guided supraclavicular block using bupivacaine or levobupivacaine in patients undergoing elective upper limb surgery.

Methods: After clearance from ethics committee, single-blinded randomized study carried out on ASA-PS I and II patients, undergoing elective upper limb surgeries under supraclavicular block, was randomly assigned two groups Group A - supraclavicular block with 0.5% bupivacaine (0.4 ml/kg) and Group B - supraclavicular block with 0.5% levobupivacaine (0.4 ml/kg).

Results: The duration of sensory and motor blockade was prolonged with levobupivacaine. The onset of sensory and motor blockade and intraoperative hemodynamics was same as bupivacaine. Complete failure and toxicity were not reported in both groups.

Conclusion: Levobupivacaine is safer and longer acting local anesthetic and its clinical profile is similar to racemic bupivacaine with reduced toxicity.

Key words: Bupivacaine, Levobupivacaine, Supraclavicular block

INTRODUCTION

Peripheral nerve blocks provide ideal operating condition when used in optimal conditions. They reduce the stress response and least interferes with the vital physiological functions of the body compared to conventional techniques. Adequately administered regional anesthesia not only provide excellent intraoperative pain relief but also give best post-operative analgesia. When we trace regional anesthesia origin, Dr. Carl Koller, a young ophthalmologist, employed a cocaine solution for topical corneal anesthesia in patients undergoing eye surgeries in 1884.[1] Most of the local anesthetic agents developed in the 1st half of the 20th century (1900–1940) were basically ester compounds. They lost their importance due to their short duration of action, systemic toxicity, and associated allergic reactions. These paved the way for the synthesis of newer agents, namely, amide type of local anesthetic agents.[2] Brachial plexus block was first performed by William Stewart Halsted in 1889. He directly exposed the brachial plexus in the neck to perform the block using cocaine.[3] Hirschel first performed the percutaneous approach of brachial plexus block.[4] Kulenkampf was the first to perform the classical supraclavicular approach to the brachial plexus block.[5] Then, Winnie and Collins

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introduced the subclavian perivascular block.[6] Raj was the first to perform the brachial plexus block through infraclavicular approach.[7] The axillary rpproach was first performed by Accardo and Adriano in 1949.[8] On subsequent days, regional blocks have been performed using nerve stimulation, anatomical landmarks and of fascia clicks. Blind blocks that rely solely on anatomical landmarks are known to produce serious complications. Even the nerve stimulation technique, recommended as the gold standard for nerve identification in regional blocks over the past decade fails to ensure an adequate level of nerve block. It also carries a risk of damage to nerve structures by direct puncture.[9] Ultrasound visualization of anatomical structures offers safe block of superior quality by optimal needle positioning. La Grange *et al.* in 1978 were the first to perform the supraclavicular block through ultrasound blood flow detector.[10] Kapral *et al.,* in 1994, published the first reported use of direct sonographic visualization for regional anesthesia.[11] However, dramatic progress has been made over the past 10 years.

Aim

This study aims to compare ultrasound-guided supraclavicular block using bupivacaine or levobupivacaine in patients undergoing elective upper limb surgery.

MATERIALS AND METHODS

A prospective, randomized study conducted on 60 ASA PS I and II presenting for elective upper limb surgeries under supraclavicular block that fulfill the inclusion criteria were divided into two groups: Group-A: Pre-operative ultrasound-guided supraclavicular block with 0.5% bupivacaine (0.4 ml/kg) and Group-B: Pre-operative ultrasound-guided supraclavicular block with 0.5% levobupivacaine (0.4 ml/kg). Systolic blood pressure, diastolic blood pressure, mean arterial pressure, and heart rate changes during intraoperative period were recorded. Onset and duration of sensory, motor blockade, and post-operative opioid requirements were recorded.

RESULTS

A total of 60 patients were included in this study, 30 patients in each group. There was no statistical difference in the age, gender, and BMI. 21 in bupivacaine group and 23 in levobupivacaine group are ASA status 1 and others in ASA status 2. There is no difference observed between both groups in pulse rate, blood pressure, and mean arterial pressure. Onset of sensory block in bupivacaine group was 7.41 ± 2.58 min and in levobupivacaine group was 6.52 ± 1.68 min which is statistically insignificant Figure 1. Onset of motor block in bupivacaine group was 10.37 ± 2.82 min and in levobupivacaine group was 9.41 ± 2.18 min which is statistically insignificant. Duration of sensory block in bupivacaine group was 591.11 ± 109.06 min and in levobupivacaine group was 746.90 ± 98.64 min (26.35%) more in the levobupivacaine group compared to the bupivacaine - by 155.79 min which is statistically significant ($P = 0.008$) Figure 2. Duration of motor block is increased to 672.62 ± 89.43 min in comparison with bupivacaine which takes 534.44 ± 110.71 min (26.98%) more in the levobupivacaine group compared to the bupivacaine group by 114.18 min which is statistically significant ($P = 0.02$) Figure 3. There was no complication in both groups during the study. Levobupivacaine group was successful in 19 out of 20 cases and in the bupivacaine group was successful in 18 out of 20 cases (2 cases of bupivacaine group and 1 case of levobupivacaine group have considered unsatisfactory block and there was no failure case Table 1).

DISCUSSION

Peripheral nerve block is a well-accepted modality to achieve clinical and economic benefits to patients in the perioperative period. The benefits include intraoperative surgical anesthesia, post-operative analgesia, and avoid general anesthetic complications. Brachial plexus block provides ideal anesthetic technique for upper limb surgeries. It was first described by Kulenkampff in 1911.[5] The use of this block has tempered by some technical complications. However, interest in supraclavicular block has been rekindled by ultrasonography. It localizes the brachial plexus structures, shows the local anesthetic distribution, and minimizes the usual technical complications. Even though we had ideal technique to block the brachial plexus, the ideal local anesthesia devoid of any toxicity is still on quest. Racemic bupivacaine is widely used local anesthetic agent for brachial plexus block.[12] However, high dosage or any inadvertent intravascular injection may cause fatalities through cardiovascular 10 and central nervous system toxicity.[13,14] These toxic effects attributed mainly from dextroenantiomer of R(+) bupivacaine.[13,15] Hence, the another enantiomer of levorotatory form of S(+) bupivacaine has less toxic effects. Hence, it emerged as safer alternative with similar clinical profile as racemic bupivacaine. Levobupivacaine has less tendency to cause cardiac toxicity due to dextroenantiomer R(+) bupivacaine has 2.4 times higher affinity for cardiac sodium channels and dissociates it from slowly than levorotatory

Table 1: Distribution of Quality of block

Quality of block	Unsatisfactory	Satisfactory	Failure	*P*
Bupivacaine	2	28	0	0.554
Levobupivacaine	1	29	0	

enantiomer.[16] Plasma protein binding of levobupivacaine is >97%, whereas bupivacaine is 95% which means availability of drug is less in levobupivacaine (<3%) to cause undesired toxic effects.[14,17] Levobupivacaine has inherent vasoconstrictor activity which gives prolonged duration of action and less systemic toxicity. Aps Reynolds study demonstrated this postulation 18. Numerous studies have been done to evaluate the efficiency of levobupivacaine as anesthetic agent in respect to onset time, duration, and analgesic qualities of brachial plexus.[18]

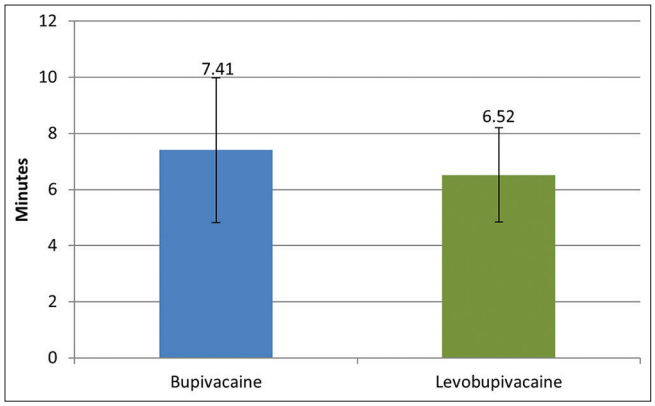

Figure 1: Onset of sensory block

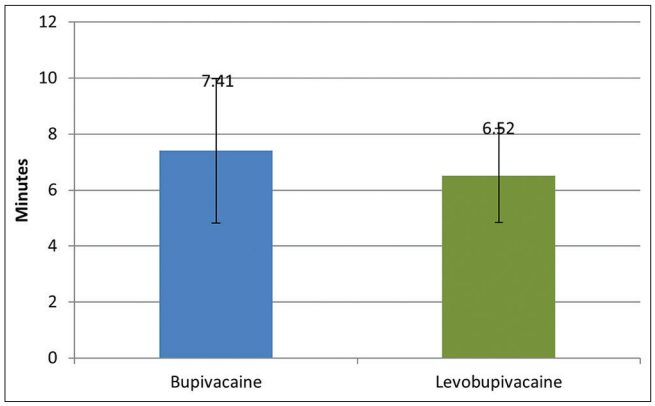

Figure 2: Duration of sensory block

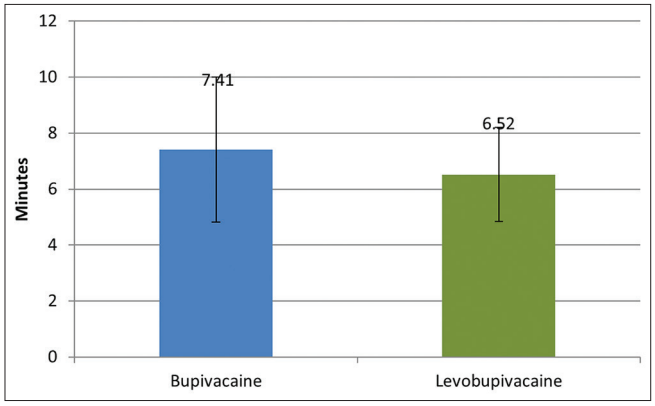

Figure 3: Duration of motor block

In the study by Sardesai *et al*., the onset of sensory block was faster in levobupivacaine group (6.13 ± 0.34 min) than bupivacaine group (7.59 ± 1.43). In the study by Cox *et al*., the onset of sensory block was faster in levobupivacaine group (6 min) than bupivacaine (8 min). In the present study, the onset of sensory block is faster in levobupivacaine group (6.52 ± 1.68) than bupivacaine group (7.41 ± 2.58) and $P = 0.1358$ so the difference is statistically insignificant.[18,19]

In the study by Shalini *et al*., the onset of motor block was faster in levobupivacaine group (5.05 ± 0.29) than bupivacaine group (5.99 ± 0.49). In the present study, the onset of motor block is faster in levobupivacaine group (9.41 ± 2.18) than bupivacaine group (10.37 ± 2.82) and $P = 0.1637$ so the difference is statistically insignificant.[19]

In the study by Shalini *et al*., the onset of motor block was faster in levobupivacaine group (1036.57 ± 93.7) than bupivacaine group (871.48 ± 174.33). In the present study, the onset of sensory block in levobupivacaine group (746.90 ± 98.64) is faster than bupivacaine group (591.11 ± 109.06) and the difference is statistically significant.[19]

In the study by Shalini *et al*., the onset of motor block was faster in levobupivacaine group (1049.46 ± 95.02) than bupivacaine group (902.37 ± 181.46). In the present study, the onset of motor block in levobupivacaine group (678.62 ± 89.43) is faster than bupivacaine group (534.44 ± 110.71) and the difference is statistically significant.[19]

In the present study, blocks with levobupivacaine group were successful in 19 out of 20 cases and in the bupivacaine group were successful in 18 out of 20 cases (2 cases of bupivacaine group and 1 case of levobupivacaine group have considered unsatisfactory block and there was no failure case). The difference is statistically insignificant.

CONCLUSION

From the study, it can be inferred that levobupivacaine is longer acting than bupivacaine and its clinical profile closely resembles to bupivacaine. Safe outcome from anesthesia is the main goal for anesthesiologist so the reduced toxic potential of this drug should be considered for regional anesthesia wherever large volume is required.

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