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Comparative Study of Analgesia and Effectiveness of Levobupivacaine and Ropivacaine in Patients Undergoing Ultrasound Guided Axillary Brachial Plexus Block

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ABSTRACT

Regional anesthesia of the upper limb can be achieved by blocking the brachial plexus at varying stages along the course of the trunks, divisions, cords and terminal branches. The aim of the study is to to compare and assess the duration of motor blockade and sensory analgesia of Levobupivacaine and Ropivacaine for patients undergoing axillary brachial plexus block under ultrasound guidance in forearm and hand surgeries.

Methods: This observational study was conducted in 100 eligible patients scheduled for elective forearm and hand surgeries in Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla. Patients who satisfy the inclusion criteria were randomly assigned to one of the two groups of 50 each: Group R patients receiving 30ml of 0.5% Ropivacaine hydrochloride with 1:200000 epinephrine and Group L patients receiving 30 ml of 0.5% Levobupivacaine hydrochloride with 1:200000 epinephrine. Modified Bromage scale is used for assessing the onset and recovery of motor blockade and sensory blockade onset is assessed using pinprick. Duration of analgesia is assessed using VNRS scale. Statistical analysis was done by SPSS software using Unpaired T test and Chi Square test.

Result: It was noted that the onset of sensory and motor blockade was faster with Ropivacaine whereas the duration of motor blockade and the duration of sensory analgesia was prolonged with Levobupivacaine.and both drugs didn't show any significant changes in hemodynamic parameters

Conclusion: When considering Ropivacaine and Levobupivacaine for brachial plexus blockade, Levobupivacaine should be considered when postoperative analgesia is a concern but not when an early return of motor activity is required.

Keywords: Levobupivacaine, Ropivacaine, Bupivacaine, Axillary brachial plexus block, Ultrasound guidance

INTRODUCTION

The introduction of anesthetic nerve blocks introduced in late 1800's heralded a new era in the management of pain. Regional anesthesia of the upper limb can be achieved by blockade of brachial plexus at its varying locations along the course of the trunks, divisions, cords or branches[1]. The benefits of brachial plexus blockade like superior pain management, decreased length of hospitalization and also fewer systemic side effects makes it a preferred alternative to general anaesthesia[2]. Traditionally, there are four main approaches for blockade of brachial plexus: interscalene, supraclavicular, infraclavicular and axillary. Each approach has its own advantages and indications[3].

The axillary approach for brachial plexus block provides satisfactory anesthesia for elbow, forearm and hand surgeries. Axillary approach is safer than the other proximal approaches as it does not risk the blockade of phrenic nerve, nor does it have the potential to cause pneumothorax, which makes it an ideal option for day case surgery[4].

Halstead in 1884 first described the axillary blockade of brachial plexus[5] and was introduced into anesthetic practice by Hirschel in 1911. Blind axillary block led to intravascular injections due to increased

vascularity of axilla. This led to the usage of ultrasound guidance in performing the block, which had a dramatic impact upon the delivery of peripheral nerve blocks. The utilization of ultrasound has resulted in a marked increase in success rates and shortened procedural times which have worked to dispel the belief that "the blocks do not work and they take too long"[6,7].

Bupivacaine is a long acting local anesthetic agent that is being conventionally used for brachial plexus blocks. The cardio toxic effects of Bupivacaine and other members of its class include hypotension, dysrhythmias and depression of cardiac activity[8]. This has led to the introduction of newer local anesthetics, Ropivacaine and Levobupivacaine which have a favorable clinical profile than conventionally used racemic Bupivacaine, in peripheral nerve blockade.

Ropivacaine is a long acting amide local anesthetic and the first produced as a pure enantiomer. Although pKa values and protein binding of Ropivacaine are similar to Bupivacaine, it has more favorable cardio toxic profile due to its lower lipid solubility and also due to its stereo selective properties[9,10].

Levobupivacaine is a long acting amide local anesthetic which is an S(–)-enantiomer of Bupivacaine. The better safety profile of Levobupivacaine confers an advantage over its racemic parent, Bupivacaine[11,12].

The main aim of this study is to compare the effects of two new local anesthetics, Ropivacaine and Levobupivacaine in patients undergoing forearm and hand surgeries under ultrasound guided axillary brachial plexus block.

OBJECTIVES

1. To compare and assess the duration of motor blockade of Levobupivacaine and Ropivacaine for patients undergoing axillary brachial plexus block under ultrasound guidance in forearm and hand surgeries.
2. To assess the duration of sensory analgesia among two groups.

METHODOLOGY

Patients were evaluated one day prior to surgery and written informed consent was obtained. NPO status achieved according to the protocol. Intra venous access was secured in all patients before shifting to the operating room. Premedication with Ranitidine 150mg, Metoclopromide 10 mg and alprazolam 0.5 mg were given on the night prior to surgery and at 6.00 am on the day of surgery.

Study Design

A prospective, observational Comparison study with two groups from March, 2018 – October,2018

Study Setting

The Department of Anesthesiology, Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla.

Sample Size

Assuming standard deviation of 6 minutes and time for censoring onset of motor blockade to be 9 minutes for 0.5% ropivacaine and 12.4 minutes for 0.5% levobupivacaine with an α error of 5% and β error of 20%, the sample size is 50 patients in each study group

Inclusion Criteria

ASA – I or ASA – II patients of either sex, in the age group of 18-65yrs, undergoing axillary brachial plexus block under ultrasound guidance for forearm and hand surgeries**.**

Exclusion Criteria

- Patient refusal
- Allergy or sensitivity to any of the study local anesthetics.
- Neuromuscular, cardiac, renal, liver diseases, coagulopathies.
- Infection at the site of block.
- Patients with peripheral neuropathy.
- Patients with BMI >35kg/m^2.
- Patients with psychiatric illness.

Pre induction monitors

NIBP [MAP], SPO2, ECG, HR

Procedure

Patients were assigned into two study groups.

- group R – given 30 ml 0.5% ropivacaine.with 1:200000 epinephrine

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- group L – given 30 ml 0.5% levobupivacaine with 1:200000 epinephrine

Consecutive subjects getting either of the two interventions were recruited till the sample size is attained.

Patients placed in supine position with the head facing away from the side of the block and ipsilateral arm abducted. Axillary area sterilized using povidone iodine solution. Axillary artery and cords of the brachial plexus identified by ultrasound probe. Axillary brachial plexus block given with 22 G needle under ultrasound guidance by in-plane method using either of the study drugs-group R 30 ml 0.5% ropivacaine with 1:200000 epinephrine and group L 30 ml 0.5% levobupivacaine with 1:200000 epinephrine.

- **Modified Bromage scale** is used for assessing the onset and recovery of motor blockade

  Grade 0: able to raise the extended arm to 90 degree for a full 2 seconds.

  Grade 1: able to flex the elbow and move the fingers but unable to raise the extended arm.

  Grade 2: unable to flex the elbow but able to move the fingers.

  Grade 3: unable to move the arm, elbow or fingers.

Duration of motor blockade was defined as the time interval between attainment of grade 2/grade 3 of motor blockade after complete administration of local anaesthetics to complete recovery of motor function (Grade 0 of modified Bromage scale).

Duration of analgesia was defined as time from loss of sensation to pin prick to administration of first rescue analgesic in the postoperative period. Sensory block onset was assessed by pinprick method

Patient is then monitored intra operatively and post operatively by **Verbal Numeric Rating Scale** [**VNRS**].The time of first rescue analgesic [injection tramadol 50 -100 mg intravenous] which is given when the VNRS is more than 4, is noted

Hemodynamic parameters were monitored every 5 minutes for the first 30 minutes and then every 10 minutes upto 2 hours after local anaesthetic administration. All patients were observed for any side effects or complications

STATISTICAL ANALYSIS

- Primary outcome variables include, Onset of sensory and motor block, degree of sensory and motor blockade, return of motor activity and post-operative analgesia.
- The independent variables assessed in this study includes the drugs given and the comparison is done using unpaired t test.
- Any categorical variables such as HR, SBP, DBP and MAP may be assessed using chi square test.

RESULTS

For all statistical evaluation, a probability value of < 0.01 was considered significant.

Analysis of Demographic data

There is no statistically significant difference between the 2 groups with respect to age of the patient included in the study.

Onset of sensory blockade was faster with Ropivacaine group compared to Levobupivacaine group and the results were statistically significant ($p < 0.01$). (Table 1)

The onset of motor blockade was faster with Ropivacaine group compared to Levobupivacaine group and the results were statistically significant ($p<0.01$). (Table 2)

Duration of analgesia was prolonged in Levobupivacaine group compared to Ropivacaine group and the results were statistically significant ($p<0.01$). (Table 3)

Duration of motor blockade was prolonged in Levobupivacaine group compared to Ropivacaine group and results were statistically significant ($p<0.01$). (Table 4)

Vitals

Comparison of Heart rate, systolic blood pressure, diastolic blood pressure,mean arterial blood pressure,and SpO2 at baseline and at different time intervals upto a time period of two hours indicate that there is no statistically significant difference ($p>0.01$) between Ropivacaine group and Levobupivacaine group.

DISCUSSION

Brachial plexus block has proved to be a safer and effective method of regional anesthesia due to its

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superior advantages over pain relief with better patient compatibility by decreasing length of hospitalization and postoperative pain.

The visualization technology using ultrasound guidance greatly reduced the possibility of occurrence of error, such as perforating vessels and local anesthetics poisoning and improved the safety. So it is the ideal option for upper limb operation[13, 14].

Despite the advantage of superior analgesia, surgeries of upper limb are still being performed mainly under general anaesthesia due to various reasons such as skill and training required for nerve blocks, inadequate, patchy or failed blocks, accidental intravascular injections, damage to nerve trunks, management of awake or lightly sedated patients, time taken to perform and establish the block etc.

Approach to brachial plexus block can be through various routes such as the interscalene, supraclavicular, infraclavicular and axillary. Each of these approaches has its own set of advantages and indications.

The axillary block has gained popularity, and is the commonly used peripheral nerve block for forearm and hand surgery due to its lower incidence of complications as compared to the other brachial plexus approaches. The axillary approach remains the safest of the four main options, as it does not risk blockade of the phrenic nerve, nor does it have the potential to cause pneumothorax, making it an ideal option for day case surgery[15, 16].

Newer local anaesthetics such as, Ropivacaine and Levobupivacaine offers favorable clinical profile than conventionally used Bupivacaine. Bupivacaine is a racemic mixture of the two stereo enantiomers dextro and levo bupivacine. The dextro enantiomer has been attributed to cardiac and central nervous system toxic effects as noted in some patients solely receiving conventional Bupivacaine.

This study was an observational comparison study carried out in Pushpagiri Institute of Medical Sciences and Research Center in 100 patients of ASA 1 and 11 scheduled for elective forearm and hand surgeries under ultrasound guided axillary brachial plexus block, who were recruited into group R and group L for Ropivacaine and Levobupivacaine with each group contaning 50 patients. The purpose of this study was to compare the effectiveness, duration and quality of sensory and motor blockade between two groups.

Analysis of patient characteristics such as age, gender and baseline hemodynamic parameters like heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, oxygen saturation between the two groups revealed no statistically significant difference. This analysis confirmed that the two groups are comparable.

Our study results showed that the onset of sensory and motor blockade were faster with Ropivacaine group (group R) compared with Levobupivacaine group (group L). The mean onset of sensory block in group R was 4.6 ± 0.8 min and 6.4 ±1.1 min in group L respectively which was statistically significant with p value <0.01. The mean onset of motor block in group R was 9.2 ±1.2 min and 15.4 ± 2.2 min in group L respectively which was statistically significant with p value <0.01. These results regarding the onset of sensory and motor blockade were slightly different from the study conducted by Erik Cline et al[17], according to whom the onset of sensory and motor blockade were comparable in both groups and statistically insignificant. However the study conducted by Susana Gonza'lez-Suarez et al study concluded that the injection of a total dose of levobupivacaine in the recommended range (30 mL of 0.33%) had a slower onset of motor block than the block produced by the same volume of ropivacaine 0.5%[18].

Comparing the duration of motor blockade, our study results showed that the Levobupivacaine group (group L) had a longer duration of motor blockade compared to Ropivacaine group (group R). The mean duration of motor blockade for Ropivacaine group was 625.7±29.1 min as compared to Levobupivacaine group which was 775.6±53.6 min. This result was statistically significant with a p value <0.01.

Also the duration of analgesia was more in Levobupivacaine group compared to the Ropivacaine group. The mean duration of analgesia in Ropivacaine group was 501.0±31.9 min and for Levobupivacaine group was 674.8 ± 33.5 min, which was statistically significant with a p value <0.01.

These results regarding the duration of motor blockade and sensory analgesia are in accordance to the study done by Erik Cline et al[17] who showed that

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the return of motor activity in Ropivacaine group was significantly faster than in the Levobupivacaine group and the duration of sensory analgesia was significantly longer in Levobupivacaine group than in the Ropivacaine group. In our study the duration of motor blockade for both Ropivacaine and Levobupivacaine group was longer than the duration of analgesia in both groups. But the study conducted by McGlade et al[19] showed nearly identical times for sensory analgesia and motor blockade for ropivacaine whereas the study done by Cox et al showed the duration of motor blockade for levobupivacaine was slightly longer than the duration of analgesia[20].

Patients remained hemodynamically stable throughout the operation. There was'nt any significant episodes of bradycardia or hypotension in either of the groups and also no signs and symptoms of accidental intravascular injection in both groups. Systolic blood pressures, diastolic blood pressures and mean arterial pressures were comparable in both groups. Oxygen saturation was maintained on 100% as the patients were on facemask with oxygen at 5 L /min.

Thus the hemodynamic parameters in the intraoperative and postoperative period upto two hours does not show any statistically significant changes in both the groups.

Newer local acting amide local anaesthetics Ropivacaine and Levobupivacaine are pure S-enantiomers of the parent drug Bupivacaine. In our study, it was noted that the onset of sensory and motor blockade was faster with Ropivacaine whereas the duration of motor blockade and the duration of sensory analgesia was prolonged with Levobupivacaine.

LIMITATION OF THE STUDY

As it was a unicentric study, ethnical variations cannot be analysed in this study.

CONCLUSION

Both Ropivacaine 0.5% and Levobupivacaine 0.5% appeared equally efficacious as long acting local anaesthetics for axillary brachial plexus block. According to our study, when considering Ropivacaine and Levobupivacaine for brachial plexus blockade, Levobupivacaine should be considered when postoperative analgesia is a concern but not when an early return of motor activity is required.

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Table 1: Onset of Sensory blockade

Group	Mean	SD	N	t	P
Ropivacaine	4.6	0.8	50	9.11	p<0.01
Levobupivacaine	6.4	1.1	50		

Table 2: Onset of motor blockade

Group	Mean	SD	N	t	P
Ropivacaine	9.2	1.2	50	17.41	p<0.01
Levobupivacaine	15.4	2.2	50		

Table 3: Duration of analgesia

Group	Mean	SD	N	t	P
Ropivacaine	501.0	31.9	50	26.56	p<0.01
Levobupivacaine	674.8	33.5	50		

Table 4: Duration of motor blockade

Group	Mean	SD	N	t	P
Ropivacaine	625.7	29.1	50	17.39	p<0.01
Levobupivacaine	775.6	53.6	50		

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