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Comparative study between 0.5% bupivacaine versus 0.5% ropivacaine in peribulbar anesthesia for cataract surgery

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ABSTRACT

Background: For intraocular surgery, the optimal local anesthetic agent must have a rapid onset of action and a sufficient duration of effect so as to enable a painless, motionless procedure without prolonging akinesia. **Aims and Objective:** This prospective, comparative observational study compares ropivacaine and 0.5% bupivacaine for cataract surgery peribulbar block. Hyaluronidase is utilized in both groups because it promotes local anesthetic diffusion. **Material and Methods:** Present prospective, observational, comparative study performed at the Department of Anesthesia Tertiary Care Teaching Institute of India for the duration of 1 year. All eligible patients were allocated in two groups as GROUP B and GROUP R. GROUP B: 10 mL of 0.5% bupivacaine and 15 I.U./mL of hyaluronidase. GROUP R: 10 mL of 0.5% ropivacaine and 15 I.U./mL of hyaluronidase. Patients were assessed for sensory block, eyelid, and ocular movements at an interval of 2 min, and Visual Analog Scale score for pain assessment. **Results:** Age and gender did not differ significantly between the two study groups, according to the findings. Comparable and similar patient characteristics distinguished the two study groups. ($P>0.05$). The difference in onset of eyelid motor blockade between the two groups was not statistically significant. The difference in the onset of motor blockade [ocular movement] between the two groups was not statistically significant ($P>0.05$). ($P>0.05$) Analgesia duration differed significantly between the two groups in a statistical sense. Ropivacaine exhibits a significantly prolonged duration of analgesic effect than bupivacaine ($P\leq0.05$). **Conclusion:** Peribulbar block utilizing 0.5% ropivacaine is a more favorable and secure option for a local anesthetic that effectively extends postoperative pain alleviation, in comparison to the use of 0.5% bupivacaine.

Key words: Analgesia; Bupivacaine; Ropivacaine; Peribulbar block

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INTRODUCTION

Cataract surgeries are the most frequently performed ophthalmic procedures worldwide, and regional or local anesthesia is preferred during these procedures. To administer anesthesia for ophthalmic procedures, an anesthesiologist and ophthalmic surgeon must possess this critical and essential skill. For the population of patients, who are frequently geriatric and have additional comorbidities, optimal surgical conditions (analgesia and akinesia) can be attained through the use of block techniques, thereby eliminating the need for general anesthesia.[1] The majority of cataract surgery patients are elderly and suffer from multiple coexisting conditions. For intraocular surgery, the optimal local anesthetic agent must have a rapid onset of action and a sufficient duration of effect so as to enable a painless, motionlessprocedure without prolonging akinesia. In this population, regional

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techniques are highly advantageous, and when general anesthesia is undesirable or contraindicated, regional anesthesia is the superior alternative. Peribulbar and retrobulbar blocks, which are regional techniques, both administer sufficient anesthesia to facilitate surgery involving the lens, anterior chamber, and cornea.[2,3]

The peribulbar block is the prevailing regional anesthetic method utilized globally to administer anesthesia for intraocular lens implantation and cataract extraction. Its efficacy for analgesia and akinesia of the eye is equivalent, and unlike retrobulbar block, it does not require a distinct facial nerve block to inhibit the activity of the orbicularis oculi muscle. Consequently, there is a greater margin of safety and fewer complications associated with peribulbar block. Thus, peribulbar anesthesia, in which a local anesthetic solution is deposited within the orbit but outside the muscle cone, has been the preferred anesthetic for cataract surgery.[4,5]

For intraocular surgery, the optimal local anesthetic agent must have a rapid onset of action and a sufficient duration of effect so as to enable a painless, motionless procedure without prolonging akinesia.

Synthesized as a purified levo enantiomer, ropivacaine is a more recent amino-amide local anesthetic. It is purported to offer effective anesthesia with motor block and to have fewer cardiovascular side effects than bupivacaine. Ropivacaine and bupivacaine both demonstrate a comparable pattern of sensory and motor blockade. The effectiveness of ropivacaine alone, in combination with lidocaine, and with lidocaine and bupivacaine was investigated by Gozdemir et al.,[6] as a peribulbar injection for cataract surgery. Trivedi et al.[7] also demonstrated that, under identical standard conditions, ropivacaine utilized in the peribulbar block was superior to a lidocaine–bupivacaine mixture in reducing intraocular pressure (IOP) and postoperative pain during intraocular surgery. In a similar vein, Trivedi et al. compared the peribulbar anesthetic efficacy of ropivacaine and a mixture of lidocaine and bupivacaine when performing vitreoretinal (VR) surgery.[8] In addition, there have been reports of its vasoconstrictive properties, which aid in the reduction of IOP through the inhibition of intraocular blood volume.[9]

This prospective, comparative analysis of 0.5% bupivacaine and 0.5% ropivacaine in the peribulbar block for cataract surgery was motivated by the aforementioned reports. Hyaluronidase is utilized in both groups because it promotes local anesthetic diffusion.

Aims and objectives

This prospective, comparative observational study compares ropivacaine and 0.5% bupivacaine for cataract surgery peribulbar block. Hyaluronidase is utilised in both groups because it promotes local anaesthetic diffusion.

MATERIAL AND METHODS

A present prospective, observational, comparative study performed at the Department of Anesthesia Tertiary Care Teaching Institute of India for the duration of 1 year. Ethical approval was taken from the institutional ethical committee and written informed consent was taken from all the participants.

Inclusion criteria

- ASA Grades I and II
- Patients between the ages of 18 and 80 who are willing to provide informed consent.

Exclusion Criteria

- Patient decline
- Coagulation dysfunction
- The presence of pre-existing significant systemic diseases
- Local infection at the site
- There are documented cases of allergies to hyaluronidase and local anesthetic agents
- Adverse drug or alcohol use history
- Uncooperative individual
- Individuals afflicted with psychiatric disorders
- Patients who are in need of sedative
- Insufficient anesthesia necessitating the readministration of local anesthetics.

Before the operation, a clinical examination was performed on each patient, which comprised a comprehensive history, general physical assessment, and systemic examination. Blood pressure, preoperative pulse, and SpO_2 were all documented. Fundamental diagnostic tests were performed, including complete blood count, renal function test, liver function test, serum electrolytes, coagulation profile, chest X-ray, and electrocardiogram (ECG). Each eligible patient was assigned to one of two categories, designated GROUP B or GROUP R.

GROUP B: 10 mL of 0.5% bupivacaine and 15 I.U./mL of hyaluronidase.

GROUP R: 10 mL of 0.5% ropivacaine and 15 I.U./mL of hyaluronidase.

Before the procedure, patients underwent cannulation using a 22-gauge intravenous cannula in the non-dominant hand. All patients will have their intraoperative pulse, oxygen saturation, noninvasive blood pressure, and ECG monitored.

A peribulbar anesthetic was administered through a two-injection technique utilizing a hypodermic needle measuring 25 mm in length and 24 gauge. The initial injection was administered through the lower lid at the intersection of the lateral one-third and medial two-thirds in every instance. The needle was initially guided along the orbital floor before undergoing a modest upward rotation. Following negative aspiration, 5 mL of local anesthetic was injected into the lower peripheral space at a depth of approximately 2.5 cm. Through the upper lid, at the juncture of the medial one-third and lateral two-thirds of the superior orbital rim, the second injection was administered. After initially being guided along the orbital roof, the needle was subsequently deflected slightly downward. Following negative aspiration, 5 mL of a local anesthetic solution was injected into the upper peripheral space at a depth of approximately 2.5 cm. A light massage and manual compression were applied to the ocular to promote the dispersion of the local anesthetic medication. For pain assessment, patients were evaluated based on their eyelid and ocular movements at 2-min intervals, sensory block, and Visual Analog Scale (VAS) score.

The sensory block was assessed by obliterating corneal sensation using cotton. This evaluation commenced 2, 4, 6, 8, and 10 min following the injection. The onset of sensory inhibition was measured from the moment of injection until corneal sensation was lost.

Eyelid movements were assessed on a three-point scale:
0 = complete inability to open the eyelids
1 = ability to open eyelids partially
2 = ability to open the eyelids completely

Ocular globe motility was evaluated in the four quadrants using a 3-point scoring system:
0 - Akinesia (ocular movement <1 mm)
1 - Reduced movement (ocular movement >1 mm but <4 mm)
2 - Normal movement (ocular movement >4 mm)

The maximum cumulative total allowed by this scoring system for the four muscles is eight. Successful blocking is denoted by reduced movements in all directions and a score of ≤2. After the effective completion of the block, no additional evaluations will be conducted.

The VAS was utilized to assess pain every 30 min until a score of 3 or higher was achieved. Upon reaching this score, the patient was administered tablet paracetamol 500 mg orally as a rescue analgesic. Effective analgesia duration is defined as the interval between the peribulbar block and the attainment of a VAS score of at least 3.

Statistical analysis

Following the compilation and entry of the recorded data into a spreadsheet application (Microsoft Excel 2007), the information was exported to the data editor tab of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). The levels of significance and confidence were established at 5% and 95%, respectively, for every test.

RESULTS

The aim of our present study is to find out the usefulness of ropivacaine, a newer local anesthetic, which is considered to have a longer duration of analgesia and lesser toxicity**.** In total, 50 patients between the ages of 18 and 80 who met the physical criteria for ASA Grades I and II were chosen to participate in this research. Each patient was separated into two distinct categories.

GROUP B: 10 mL of 0.5% bupivacaine and 15 I.U./mL of hyaluronidase.

GROUP R: 10 mL of 0.5% ropivacaine and 15 I.U./mL of hyaluronidase.

Age and gender differences between the two study groups were not statistically significant (Table 1). Comparable and similar patient characteristics distinguished the two study groups (P>0.05). Age and gender differences between the two study groups were not statistically significant. Comparable and similar patient characteristics distinguished the two study groups (P>0.05). The difference in onset of eyelid motor blockade between the two groups was not statistically significant (P>0.05)

Using Chi-square test, it was observed that the onset of motor blockade [Ocular movement] between the two groups was statistically not significant (P=0.09) (Table 2).

Using Chi-square test, it was observed that the duration of analgesia between the two groups was statistically significant. Ropivacaine has a longer duration of analgesia when compared with bupivacaine (P=0.03) (Table 3).

DISCUSSION

This study was done in our institution, where we use a mixture of bupivacaine and hyaluronidase. On the statistical analysis of the data obtained from 50 patients (25 patients in each group) with similar demographic profile, we found that there was no statistically significant difference between the Group B and Group R with regard to onset of sensory blockade, onset of motor blockade (eyelid), and onset of motor blockade (ocular movement). Regarding the duration

Table 1: Demographic data of study participants

Demographic data		
Groups	**Age (year), mean±SD**	**Sex (male/female)**
Group B	60.04±11.15	13/12
Group R	58.04±14.57	12/13
P	0.59	1

P<0.05: Significant, P>0.05: Not significant. Test applied - Student's t-test.
SD: Standard deviation

Table 2: Onset of motor blockade (ocular movement)

Onset (min)		
Time (min)	**Frequency (%)**	
	Group B	**Group R**
6	3 (12)	1 (4)
8	13 (52)	9 (36)
10	7 (28)	10 (40)
15	2 (8)	5 (20)

Statistically not significant (P=0.09)

Table 3: Duration of analgesia

Duration (min)		
Time (min)	**Frequency (%)**	
	Group B	**Group R**
121–240	9 (36)	6 (24)
241–360	13 (52)	10 (40)
361–480	3 (12)	9 (36)

of analgesia, our study showed a statistically significant prolongation of the duration of analgesia with Group R as compared to Group B. From our study, we found that the total duration of sensory blockade, which the patients benefit as an effective postoperative analgesia, is statistically significant with 0.5% ropivacaine, a newer local anesthetic in peribulbar block.

Similar to our study, Varshney et al.[8] reported better postoperative anesthesia with ropivacaine as compared to combined lignocaine and bupivacaine. However, this study was limited only to macular surgeries, where the globe manipulation was minimal. Similar to our study, Sinha et al.,[10] in their series of 919 VR surgeries, found total akinesia in 87.5% and analgesia (no pain) in 93% of the operated cases. However, they assessed these parameters 15 min after the block. Since we assessed the parameters after 5 min, we could comment on the onset of akinesia and analgesia. Perello et al.[6] in their randomized control trial compared the efficacy of plain ropivacaine with bupivacaine–lidocaine and ropivacaine–lidocaine mixtures for peribulbar blocks in cataract surgery. Unlike our study, they did not find an early onset of akinesia and analgesia with ropivacaine. However, they had used a lower concentration, 0.5% ropivacaine. Similar differences in onset, based on the concentration of the drug used have been shown by Jaichandran et al.,[11] in the interscalene brachial plexus block. Varshney et al. concluded that ropivacaine was a good alternative for peribulbar anesthesia compared to bupivacaine/lignocaine as it has a faster onset and lesser toxic effects than other comparable local anesthetic agents.[8]

Peribulbar block involves the administration of local anesthetic into the muscle orbicularis oris both above and below the orbit. This technique blocks the ciliary nerves in addition to CN III and VI; however, the optic nerve remains unobstructed during this form of local anesthesia. Due to the fact that the local anesthetic is deposited externally to the muscle, intraocular or intradural injections are extremely uncommon. The peribulbar block is a straightforward procedure that significantly reduces the likelihood of intramuscular hemorrhage and optic nerve damage. Although achieving a dense block is challenging with this peribulbar block technique, it remains a prevalent regional block due to its low incidence of complications.[12]

In comparison to general anesthesia, regional anesthesia is associated with a reduced incidence of respiratory and cardiovascular complications, which contributes to its widespread use in ophthalmic surgery. In addition, regional anesthesia reduces the incidence of vertigo and vomiting and provides postoperative pain relief. When conducting an intraocular ophthalmic procedure, the most critical parameters to evaluate are post-operative comfort, akinesia, and intraoperative pain alleviation. Both ropivacaine and bupivacaine, which were utilized in this research, are long-acting local amide anesthetics. Ropivacaine is a purified enantiomer, whereas bupivacaine is a racemate compound. The local anesthetic's proton binding ability (pKa) dictates the penetration time of the solution. Specifically, the pKa values for lidocaine are 7.7 and 8.3, respectively, for bupivacaine and ropivacaine. This difference in pKa values significantly influences the time at which analgesia is initiated. The pKa values of the local anesthetic are correlated with the rate of rapid onset of analgesia. The plasma-to-protein binding rates for bupivacaine and ropivacaine are 94% and 95%, respectively. The duration of action of a local anesthetic will be proportional to its binding capability. It is widely believed that bupivacaine exerts its analgesic effects more rapidly and for a prolonged period. Vasoconstriction is the primary factor responsible for the IOP reduction through intraocular volume reduction.[13]

Limitation of the study

One of our study limitations is that we did not assess postoperative discomfort at the injection site.

CONCLUSION

About 0.5% ropivacaine given for peribulbar block is a better and safer choice of a local anesthetic to prolong the postoperative pain relief when compared to 0.5% bupivacaine.

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NR- Concept and design of the study, prepared first draft of manuscript; **SMS-** Interpreted the results; reviewed the literature and manuscript preparation; **SPV-** Concept, coordination, preparation of manuscript; **SRS-** statistical analysis and interpretation; PKU- prepared draft of manuscript; **PPV-** statistical analysis.

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