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Original Research Article

A Comparative Study of 2% Lidocaine Plus 0.5% Ropivacaine Versus 2% Lidocaine Plus 0.5% Bupivacaine for Peribulbar Anaesthesia in Cataract Surgeries

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Abstract

Background: Generally, to perform the Peribulbar anaesthesia, different mixtures of local anaesthetics are used, the most common of which are lidocaine and bupivacaine. It was observed that overdose of bupivacaine proves to be serious because of its cardiotoxic effects. Even more it responded poorly to the traditional resuscitation methods. This study evaluated the efficacy of bupivacaine and ropivacaine. To assess the efficacy hyaluronidase and lidocaine were used to combine the two. Here, for the patients of cataract surgery, two-point injection technique was used for peribulbar anaesthesia.

Aim: To assess bupivacaine's and ropivacaine's efficacy each of which were combined with hyaluronidase and lidocaine.

Material and Methods: It was a randomized double-blind study performed at the Department of Anaesthesia and Critical Care at the Srirama Chandra Bhanja Medical College & Hospital in Cuttack during the period of October 2014-16 on sixty patients admitted for cataract surgery in the peribulbar division. Group A of 30 patients received 3ml of 0.5% ropivacaine plus 4ml of 2% lidocaine plus 22.5 International Unit (IU) of Hyaluronidase, and Group B of 30 patients received 3ml of 0.5% bupivacaine plus 4ml of 2% lidocaine plus 22.5 International Unit (IU) of Hyaluronidase.

Results: The study found significant difference in Onset of akinesia (mins) between two groups ($p<0.001$). Further, in Group A, there was no highly significant change in intraocular pressure after peribulbar anaesthesia, whereas highly significant increase in intra ocular pressure was observed when compared to preoperative value in Group B. The intraocular pressure and duration of akinesia was significant in the Group B than in Group A. The study further recorded a significant difference in the onset of analgesia between Group A and Group B ($p<0.00$).

Conclusion: On basis of the study, it was concluded that bupivacaine + lignocaine is an inferior alternative to ropivacaine + lignocaine for treating patients with peribulbar anaesthesia to be

used in cataract surgeries. This was because of the reason that it has better efficacy without any type of cardiovascular toxicity.

Keywords: Ropivacaine, Bupivacaine, Cataract Surgeries

Introduction

For over 1000 years, little to no anaesthesia had been used in performing eye surgeries. Over the years, different local anaesthetic techniques have been evolved and now it consists of both akinetic (needle or cannula-based techniques) as well as non-akinetic (topical anaesthesia) techniques. Obtaining good analgesia and akinesia without any complications and issues is among the multiple goals of safe and effective anaesthesia in intraocular surgeries.

Ever since Knapp (1984)[1] described retrobulbar anaesthesia, only recently it was the choice of anaesthesia when the ocular surgeons, around the world, explained different local and systemic complications because of its development and formulations.

Bajwa and Bajwa (2014)[2] describe peribulbar anaesthesia technique used in cataract surgeries as safe and a widely used practice[3]. Unlike the retrobulbar anaesthesia, the peribulbar anaesthesia does not require separate facial nerve block and have fewer complications. Peribulbar block is extraconal block & does not cause globe perforation and optic nerve damage but as retrobulbar is intaconal block, may cause globe perforation & optic nerve damage. Although retrobulbar block provides reliable anaesthesia, it is not as safe as peribulbar block. Hence Peribulbar block is more practises for surgeries such as cataract.

Local anaesthesia such as lidocaine and bupivacaine are commonly used as peribulbar anaesthesia. Since the introduction of bupivacaine, it has come to the light that its accidental overdose has proved to be fatal. This is because of its cardiotoxic effects and poor response to the conventionally used resuscitation methods[4]. In the year 1996 introduction of aminoamide, ropivacaine, a derivative of mepivacaine was done. It is considered to be a safer and effective alternative to using the bupivacaine. It consists of different types of properties that are similar to that of bupivacaine, but it is less than that of neurotoxic and cardiotoxic[5]. Aim of the current study is to assess bupivacaine's and ropivacaine's efficacy each of which were combined with hyaluronidase and lidocaine. A two-point injection technique is used to perform the peribulbar anaesthesia in patients admitted for cataract surgery.

Material and Methods

It was a randomized double-blind study performed at the Department of Anaesthesia and Critical Care at the Srirama Chandra Bhanja Medical College & Hospital in Cuttack during the period of October 2014-16 on sixty patients admitted for cataract surgery in the peribulbar division using generated random sequence table. Group A of 30 patients received 3ml of 0.5% ropivacaine plus 4ml of 2% lidocaine plus 22.5 International Unit (IU) of Hyaluronidase, and Group B of 30 patients received 3ml of 0.5% bupivacaine plus 4ml of 2% lidocaine plus 22.5 International Unit (IU) of Hyaluronidase.

All patients were given tablet alprazolam 0.5mg orally in the previous night of surgery. An ophthalmology resident, who was not associated with the current study in any capacity, was asked to load the study drugs and the operating surgeon was responsible for performing the peribulbar anaesthesia. Group A received 3ml of 0.5% ropivacaine plus 4ml of 2% lidocaine plus

22.5 International Unit (IU) of Hyaluronidase, and Group B received 3ml of 0.5% bupivacaine plus 4ml of 2% lidocaine plus 22.5 International Unit (IU) of Hyaluronidase.

Intra ocular pressure was measured in all patients before the block using a Schiotz tonometer and it is recorded as baseline value. Then peribulbar block was given. In this context, 5% povidone solution was used to clean the eyelids and its surrounding areas. In the current study, a 10cc syringe was used containing 7cc worth of anaesthetic solution used with a 23-gauge needle. 4ml of inferolateral quadrants was injected at the junction of 2/3rd and lateral 1/3rd of lower lid once the eye was in the main position of gaze.

In similar manner, 3ml of anaesthetic solution was injected at the superonasal quadrant, at the junction of medial 2/3rd and lateral 1/3rd of the upper lid. Furthermore, ocular compression was applied as well, but only for a few minutes. Bi-nasal prongs with oxygen flow of 3L/min was used to administer oxygen. As Fig 1, Visual Analog Score (VAS) was used to assess the Analgesia.

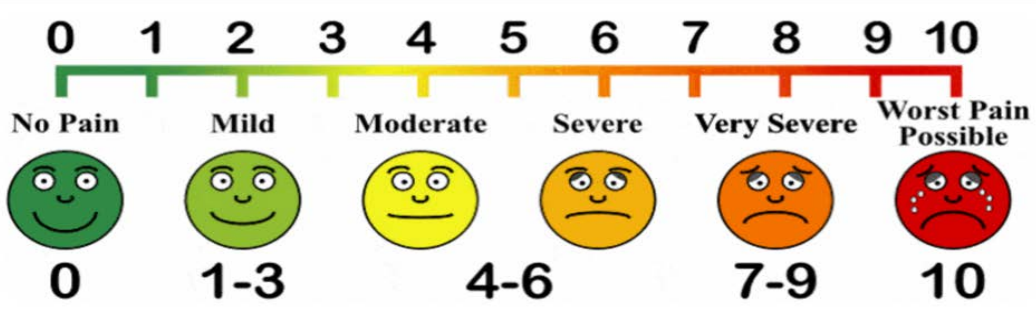

Figure 1: Visual Analog Score (VAS)[*6*]

The Eyelid & Global akinesia scoring was recorded thereafter using the Akinesia Scoring System as shown in Fig 2 below:

Akinesia of extraocular muscles, including the levator muscle

0 = 0–1 mm movement in one or two main directions or 0–4 mm movement in the levator muscle.

1 = 2 mm movement in any main direction or 1 mm movement in more than two directions or > 4 mm movement in the levator muscle.

2 = > 2 mm movement in any main direction or 2 mm movement in two or more main directions.

Akinesia of orbicular muscle

0 = Complete akinesia.

1 = Partial movement in either or both eyelid margins.

2 = Pronounced movement in either or both eyelid margins.

Figure 2: Akinesia Scoring System[*7*]

Inclusion Criteria

The inclusion criteria used in the current study was that the patients with the American Society of Anaesthesiologists (ASA) from grade I and II of any of the gender were recruited in the study. Further,

those patients aged between 42-72 years, regardless of their grade of cataract, along with Intra ocular pressure, not having cardiac, or renal, or respiratory or hepatic, or hormonal disorder, and those who had normal baseline Electro-Cardio-Gram (ECG) rhythm were included and recruited in the current study.

Exclusion Criteria

Those patients who were of grade III and IV from the American Society of Anaesthesiologists, and those who had any comorbid conditions, or who had any significant cognitive impairment and psychiatric disorder and apprehensions that require sedatives and analgesics were excluded from the current study. Further, patients who had any eye disorder or who are allergic to lidocaine and hyaluronidase, and inadequate anaesthesia that require the reinjection of local anaesthetics were also excluded from the current investigation.

Statistical Analysis

To analyse results, the researcher used Statistical Software for Social Sciences (SPSS) 27.0 was used. Herein, frequency and descriptive analysis was carried out on the demographic data. Further, a t-test was also performed on the same data to determine difference among the two groups, while the level of significance ($p<0.05$) was used in the current investigation.

Results

The mean age was 58.4 years and 60.97 years for Group A and Group B respectively ($p=0.182$). In the Group A 33.3% (N = 10) were female participants and 66.7% (N = 20) were male. While, in the Group B, 60% (N = 18) were male participants and 40% (N = 12) were female participants ($p = 0.592$).

Table 1: Comparing Eyelid Akinesia Score

Time(mins)	Group A			Group B		
	0	**1**	**2**	**0**	**1**	**2**
2	76.7	13.3	10	0	0	100
4	100	0	0	0	0	100
6	100	0	0	0	6.7	93.3
8	100	0	0	10	90	0
10	100	0	0	100	0	0
15	100	0	0	100	0	0
30	100	0	0	100	0	0
45	20	66.7	13.3	100	0	0
60	0	6.7	93.3	100	0	0
90	0	0	100	0	86.7	13.3

120	0	0	100	0	86.7	13.3
150	0	0	100	0	86.7	13.3
180	0	0	100	0	0	100

Table 1 shows that 76.7% (N = 23) at two minutes, 100% (N = 30) at four minutes, and 100% (N = 30) at six minutes participants from Group A had an eyelid akinesia score of grades zero. Further, 10% (N = 3) at two minutes had grade two, and by the fourth minute none of the patients had eyelid akinesia score of grades two. While, at the 45th minute, grade one score among 66.7% (N =20) patients, and by 60th minute 93.3% (N = 28) patients had an eyelid akinesia score of grades two. On the other hand, at 6th minute, 93.3% (N = 28) patients reported grade two scores and at 10th minute, all of the patients had zero eyelid akinesia score. Further, after the end of 60th minute none of the patients had grade, one scores and by 90th minute, 86.7% (N = 26) patients had a grade one score.

Table 2: Comparing Global Akinesia Score

Time (mins)	Group A			Group B		
	0	**1**	**2**	**0**	**1**	**2**
2	63.3	26.7	10	0	0	100
4	100	0	0	0	0	100
6	100	0	0	0	13.3	86.7
8	100	0	0	46.7	46.7	6.7
10	100	0	0	83.3	16.7	0
15	100	0	0	93.3	6.7	0
30	100	0	0	100	0	0
45	60	40	0	100	0	0
60	6.7	46.7	46.7	93.3	6.7	0
90	3.3	10	86.7	83.3	16.7	0
120	0	3.3	96.7	6.7	76.7	16.7
150	0	0	100	0	13.3	86.7
180	0	0	100	0	6.7	93.3

Table 2 compares Global Akinesia Score in group A and Group B ant different point of time.

Table 3: Comparing between Groups

Parameters	Group A	Group B	P-value
Onset of akinesia (mins)	2.73	9.9	0.001
Intraocular pressure changes-Before	12.0±1.13	14.40±1.40	0.04
Intraocular pressure changes-After	12.87±1.04	20.43±3.24	0.000
Intraocular pressure after peribulbar anaesthesia	12.87±1.04	20.43±3.24	0.000
Duration of akinesia	56±11.77	115±19.43	0.000
Onset of analgesia	3.73±0.98	4.30±1.02	0.000
Duration of analgesia	238.70±18.60	250.46±19.38	0.000

From table 3, following observations can be made:

- There was significant difference in Onset of akinesia (mins) between the groups ($p<0.001$).
- There was no highly significant change in intraocular pressure after peribulbar anaesthesia in Group A, whereas in Group B, highly significant increase in intra ocular pressure was observed when compared to preoperative value.
- In comparison to Group A, the increase in intraocular pressure in the Group B was highly significant.
- Group B had significantly longer duration of akinesia than Group A

Table 4: Comparing Hemodynamic between Group A and Group B

Time in mins.	MEAN HEART RATE				MEAN ARTERIAL PRESSURE			
	Group A		Group B		Group A		Group B	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0	75.43	5.734	77.57	4.659	90.87		88.33	9.596
2	78.2	6.122	78	5.395	93.87	9.273	93.67	9.121
4	78.4	5.905	75.17	3.228	85.17	7.905	90.47	10.54
6	78.8	6.15	75.33	4.097	88.13	8.525	94	10.017
8	76.3	6.154	76.17	4.364	88.1	8.672	92.23	9.372
10	74.97	3.528	75.73	4.556	89.53	8.796	92.37	7.407
15	77.07	5.795	76.23	5.482	87.83	9.556	93.3	10.083
30	78.5	5.335	79.27	5.42	90.27	8.913	94.57	8.003
45	78.4	5.905	79.13	6.585	86.3	8.522	91	9.592
60	78.8	6.15	77.2	6.25	91.3	7.424	95	8.84
90	78.1	5.359	77.3	6.934	91.33	9.444	95.4	10.417
120	80.3	7.003	76.4	7.704	91.07	8.706	97.13	8.08
150	76.5	5.387	75.97	4.701	93.2	8.923	93.57	8.435
180	76.43	7.686	76.7	4.699	94.73	7.311	96.47	8.621

Table 4 results show that in Group A there is little difference in heart rate then Group B. No patient in any group showed bradycardia. Further, there are similar changes in both the Groups in the Mean Arterial Pressure from the base line.

Discussion

In ophthalmic surgeries, the role of anaesthesia is very important. In this regard, vast majority of cataract surgeries are performed using peribulbar anaesthesia. It is essentially a technique that has gained a significant popularity in recent years. It has become more popular than the retrobulbar technique. Using the peribulbar anaesthesia technique has an added advantage that it causes hypotony of the globe because of the loss of the extraocular muscle tone. Ropivacaine, a local anaesthetic technique introduced only recently, consists of properties that

are similar to that of bupivacaine, but it is less neurotoxic and cardiotoxic. Until recently, the two-point peribulbar anaesthesia technique was a frequently used one, even though the bupivacaine technique was considered to be more appropriate. But the mixture of lidocaine-bupivacaine is being currently used as lidocaine. It reacts quickly while the bupivacaine works on long postoperative pain relief benefits.

Therefore, in the current study, the effects of the two local anaesthetics – ropivacaine and bupivacaine were compared. Each of their administration with lidocaine is largely dependent on the quality of block attained after the peribulbar anaesthesia. In the current study, the two groups were divided on the basis of age, weight, and gender.

Onset and Recovery of Akinesia

Results of the current study showed that in ropivacaine along with lignocaine group, 63.3% (N = 19) patients had a global akinesia score of grades zero and two minutes, while all the participants also had a grade zero score by the fourth minute. However, Huha et al[7], determined a faster development of akinesia in the ropivacaine + lignocaine than that of the bupivacaine + lignocaine at the two-minute mark. One of the reasons for such a difference can be attributed to a higher concentration of ropivacaine.

Here, the mean onset time in ropivacaine + lignocaine group was 2.7 minutes and, in the bupivacaine, + lignocaine group it was 9.9 minutes. Nociti et. al[8] found that certain percentage of patients had shown a successful block and was higher at the one- and three-minute intervals in ropivacaine + lignocaine group after the injection of bupivacaine + lignocaine. While, at the 14th minute mark, all patients from both the groups reported successful peribulbar anaesthesia. On this basis it can be said that ropivacaine + lignocaine has a quicker onset of action than the bupivacaine + lignocaine.

The vitreo retinal surgery performed by Gioia et. al[9] using the peribulbar anaesthesia, found that the surgical block can be achieved after 8±5 minute in the lidocaine-bupivacaine group, as compared to the 10±5min in the ropivacaine Group (without lidocaine). The author concluded that onset of lidocaine-bupivacaine mixture and ropivacaine are similar, even after using a higher concentration of ropivacaine, which amounted to only 0.75% in their study.

Similar onset could be due to confounding factors like lidocaine, which was added only to bupivacaine and not ropivacaine. The findings of Perello et al.[10] strengthens the results, as it shows a slower onset of the akinesia by using the ropivacaine alone.

Results of the current study showed that the time to recover from peribulbar anaesthesia was at 56 minutes in the ropivacaine +

lignocaine group, while it was 115 minutes in the bupivacaine + lignocaine group. In contrast, on the basis of findings of Huha et al[7] it can be said that there is no difference in the duration of action among the ropivacaine and bupivacaine. But ropivacaine was used by Simpson et al[11] only for giving regional anaesthesia and for dealing with acute pain management. The authors further found that there is a lower incidence of motor block in ropivacaine than in the bupivacaine. It can be a great benefit for dealing with post-operating as well as labour pain.

Intraocular pressure (IOP)

According to Nociti et al[8] found that the value of average intraocular pressure was 12.87±1.04 in the ropivacaine Group when contrasted with 20.4±3.24 in bupivacaine Group, this impact is most likely clarified by vasoconstriction delivered by ropivacaine prompting more modest intraocular blood volume. The present noticed a huge increment of mean Intraocular pressure (IOP) (mm Hg) in bupivacaine + lignocaine Group from 14.40 to 20.43 while in ropivacaine + lignocaine Group it expanded from12.0 to 12.87 after peribulbar sedation.

Ozcanet et. al[12] saw that bupivacaine-lidocaine blend expanded Intraocular pressure (IOP) from 15.1±2.5 to 17.8±2.5 after the peribulbar sedation, while ropivacaine decline Intraocular pressure (IOP) from 15.8±2.3 to 13.5±2.3. This expansion in Intraocular pressure (IOP) by bupivacaine-lidocaine combination might be because of vasodilation brought about by lidocaine. Be that as it may, this perplexing component was missing in present review, as lidocaine was utilized in the two Groups. This impact of lidocaine might have brought about shortfall of any fall in Intraocular pressure (IOP) with ropivacaine in our review. Despite the fact that there was ascend in Intraocular pressure (IOP) with ropivacaine + lignocaine, it was fundamentally lower when contrasted with that of bupivacaine + lignocaine Group.

According to Olmez et al[13], even though the intraocular pressure level of the ropivacaine group at the ten-minute mark was considerably lower than the desired or the baseline levels. As per their findings, there was no statistically significant difference in the intraocular pressures among the two groups. On this basis, it can be said that ropivacaine has vasoconstrictive properties. This is mainly due to the reason that adrenaline forces the vasoconstriction that leads to similarity between the two groups.

Results of Goveia et al[14] are also similar to this. The authors argue that the average intraocular pressure levels in the ropivacaine group was 13.1±2.26 mmHg, while in the bupivacaine group before the blockade it was 13.28±2.35 mmHg. It was further noted that there was an increase in intraocular pressure in the bupivacaine group, as the score increased to15.62±4.31 mm Hg just after five minutes of the peribulbar anaesthesia, but it decreased to 12.98±2.71 mm Hg in the ropivacaine group.

Cardiovascular Effects

According to Luchetti et al[15], frequency of cardiac arrhythmias was more in the bupivacaine-mepivacaine group than in the ropivacaine group. The authors further observed minor cardiac arrhythmias in 2.2% of the patients in the ropivacaine group, and in 8% patients from the bupivacaine-mepivacaine group.

The effects of intravenous infusion of bupivacaine and ropivacaine both at the rate of 10 mg/min were assessed by Scott et al[16]. They found that there was evidence of depression of conductivity and contractility was displayed by both the groups at lower doses and lower plasma concentrations with ropivacaine and bupivacaine. Similar study was performed by and found that there was an increase in

the width of QRS during sinus mood swings in comparison to treating placebo with ropivacaine. They also recorded a decline in capacities of both the left ventricular systolic and diastolic, while the use of ropivacaine reduced only the systolic capacity.

Even though past studies suggest better cardiac profiling for ropivacaine than bupivacaine, but a vast majority of these studies are performed either using direct intravenous infusion of drugs, or they are performed in animals and thus, their results can be used in human for regional anaesthesia.

McLure et. al[17] support these results, even though the authors did not find any difference in the frequency of negative cardiac effects among the ropivacaine group and the lidocaine and bupivacaine group. According to Fujita et. al[18], who performed an animal study, found that lidocaine weakens any conduction abnormality induced by bupivacaine. But, in the current study no direct comparisons with ropivacaine + lignocaine or the bupivacaine + lignocaine did not produce any cardiovascular toxicity when the patients were administered for peribulbar anaesthesia. The study further revealed that regardless of the safety margins, in comparison to the local anaesthetics, toxic reactions with ropivacaine + lignocaine is still possible. Therefore, attention must be given while administering any highly concentrated local anaesthetics[19].

Onset and Duration of analgesia

The present study showed that in ropivacaine + lignocaine Group the minimum time required for onset of analgesia was 3 mins and maximum of 5 minutes with an average 3.73 mins. Average duration for Group B was 4.3 min, showing significant difference in two groups ($p = 0.000$). The study by Trivedi et al[20] reported assessment of sensory onset, motor onset with respect to bupivacaine, ropivacaine were comparable in two groups ($p > 0.05$).

Khan et al[21] who reported onset of sensory anaesthesia of Group received 2% lidocaine, 0.75% ropivacaine and 100 units of hyaluronidase was (4.6±2.1). Onset and establishment of sensory and motor blocks were significantly earlier in the ropivacaine clonidine group (p value<0.05). In present study, the mean duration of analgesia was 238.70 mins in ropivacaine + lignocaine group and 250.46 mins bupivacaine + lignocaine group, whereas Trivedi et al[20] showed mean first anaesthetic request for 0.75% Ropivacaine Group was 276.83 mins and 257.83 mins for 0.5% Bupivacaine Group with p value > 0.05.

However, Khan et al [21] used Ropivacaine, lidocaine and hyaluronidase for peribulbar anaesthesia and reported that Duration of analgesia was 4.2 hr. Duration of analgesia was prolonged in the Ropivacaine, clonidine group 6.5hrs as compared to ropivacaine group with p value 0.004.[22]

Limitations of Present Study

- Complications of peribulbar anaesthesia were not recorded.

Scope for Further Studies

- Intraoperative monitoring with echocardiography can be used to compare cardiovascular toxicity of bupivacaine and ropivacaine.
- Effect of premedication on intraocular pressure changes with ropivacaine or bupivacaine can be studied.

Conclusion

Peribulbar anaesthesia is normally performed with different types of local anaesthetics, most commonly used ones are lidocaine and bupivacaine. Since the introduction of bupivacaine, it has come to the light that its accidental overdose has proved to be fatal. Intra ocular pressure was measured in all patients before the block

using a Schiotz tonometer and it is recorded as baseline value. Then peribular block was given. In ophthalmic surgeries, the role of anaesthesia is very important. In this regard, vast majority of cataract surgeries are performed using peribulbar anaesthesia. It is essentially a technique that has gained a significant popularity in recent years. It has become more popular than the retrobulbar technique.

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