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Original Research Article

Comparison of Bupivacaine, Lignocaine, Hyluronidase versus Bupivacaine, Lignocaine, Hyluronidase and Clonidine in Peribulbur Block for Cataract Surgery

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Abstract:

Background: Cataract surgery is one of the most frequently performed ophthalmic procedures worldwide. Peribulbar block is a commonly used regional anesthesia technique for these surgeries due to its safety and efficacy, particularly in elderly patients with comorbidities. This study aimed to evaluate the effectiveness of a combination of lignocaine, bupivacaine, and hyaluronidase with and without clonidine at two doses (0.5 µg/kg and 1 µg/kg) for enhancing the quality and duration of analgesia during peribulbar anesthesia.

Materials and Methods: This randomized, double-blind, prospective study was conducted on 120 patients aged 40–80 years undergoing cataract surgery at a tertiary care hospital in Pune, India, over one year. Patients were randomized into three groups of 40: Group A received a mixture of lignocaine, bupivacaine, and hyaluronidase; Group B received the same mixture with 0.5 µg/kg clonidine; and Group C received the mixture with 1 µg/kg clonidine. The onset of sensory and motor blockade, duration of analgesia, and hemodynamic parameters were assessed. Statistical analyses included Bartlett's χ^2 test, Kruskal-Wallis one-way ANOVA, and paired Student's t-test.

Results: The addition of clonidine significantly reduced the onset time for sensory blockade (Group A: 4.7 ± 2.1 min; Group B: 3.7 ± 1.5 min; Group C: 3.2 ± 1.2 min) and motor blockade (Group A: 7.3 ± 2.6 min; Group B: 4.2 ± 2.4 min; Group C: 3.5 ± 1.2 min). Clonidine also prolonged the duration of analgesia, with values of 187.6 ± 23.1 min, 243.2 ± 27.0 min, and 341.3 ± 32.1 min for Groups A, B, and C, respectively. Hemodynamic parameters and side effects, including mild sedation and dry mouth, were within acceptable limits.

Conclusion: Clonidine is an effective adjuvant in peribulbar block, enhancing the quality of anesthesia by reducing onset time and prolonging analgesia. The 0.5 µg/kg dose provides an optimal balance of efficacy and safety, making it a preferred choice for cataract surgery. Further studies with larger populations are recommended to validate these findings.

Keywords: Cataract surgery, peribulbar block, lignocaine, bupivacaine, clonidine, hyaluronidase, analgesia, anesthesia efficacy.

Introduction

Cataract surgery is one of the most commonly performed ophthalmic procedures globally, primarily aimed at restoring vision in patients affected by opacification of the natural lens [1]. The choice of anesthesia for cataract surgery plays a crucial role in the procedure's success, especially considering the advanced age and associated comorbidities of most patients undergoing the surgery [2]. While general anesthesia is an option, its use is often limited due to the increased risks of morbidity and mortality in elderly patients with multiple chronic diseases [3]. Consequently, regional anesthesia techniques, particularly peribulbar anesthesia, have gained widespread acceptance for cataract surgeries due to their efficacy and safety profile [4]. Peribulbar anesthesia involves the administration of local anesthetic agents into the peribulbar space to block sensory and motor nerves supplying the eye. However, the duration of the block remains a challenge, particularly during prolonged procedures [5]. Various adjuncts have been explored to enhance the quality and duration of anesthesia. Hyaluronidase, an enzyme that facilitates the dispersion of local anesthetics, has been shown to accelerate the onset and improve the efficacy of the

block [6]. Clonidine, a partial alpha-2 adrenergic agonist, has emerged as a valuable adjunct in regional anesthesia. It potentiates the effects of local anesthetics, prolonging analgesia and providing opioid-independent pain relief [7]. Studies have demonstrated that the addition of clonidine reduces the onset time of sensory block and extends the duration of adequate anesthesia. However, higher doses of clonidine have been associated with sedation and hemodynamic effects, necessitating careful dose selection [8]. Given these considerations, this study aims to evaluate the effectiveness of a combination of lignocaine, bupivacaine, and hyaluronidase with and without clonidine in terms of the quality and duration of analgesia during peribulbar block for cataract surgery.

Materials and Methods

This randomized, double-blind, prospective, and comparative study was conducted at a tertiary care teaching hospital in Pune, India, over one year from April 2013 to March 2014. The study aimed to evaluate the quality and duration of analgesia provided by different combinations of local anesthetics and adjuvants during peribulbar block in cataract surgery.

The sample size was determined based on a target population of 20,000 patients, with a 95% confidence level and a margin of error of ±9%. The calculated sample size was 118 patients, and accounting for a 2% dropout rate, a total of 120 patients were included in the study. These patients were scheduled for elective cataract surgery under peribulbar block and provided informed consent for participation. Routine preoperative clinical examinations and laboratory investigations were carried out for all patients. Participants were randomized into three groups of 40 each (n=40) using systematic random sampling. Group A received 10 mL of a mixture comprising 5 mL of 2% lignocaine, 5 mL of 0.5% bupivacaine, and 75 U hyaluronidase. Group B received the same mixture with the addition of clonidine at a dose of 0.5 µg/kg, while Group C received the mixture with clonidine at a dose of 1 µg/kg. Randomization was achieved using sealed envelopes handled by a resident uninvolved in other study aspects, ensuring blinding. The prepared solutions were labelled as "study drug" to maintain blinding for the patients, surgeons, and nursing staff.

The inclusion criteria for the study were patients aged 40 to 80 years, classified as ASA physical status I or II, and scheduled for cataract surgery under peribulbar block. Patients were excluded if they had a history of cardiac disease (ischemic heart disease, rhythm abnormalities, or uncontrolled hypertension), ocular infections, single eye, diagnosed glaucoma, or known allergies to the study drugs. Patients refusing consent were also excluded. Peribulbar block was administered by an experienced resident who had performed at least 50 blocks previously. The anesthetic solution was injected at two sites: the junction of the medial two-thirds and lateral one-third of the lower eyelid and the junction of the lateral two-thirds and medial one-third of the upper eyelid. Orbital compression using a rubber ball was applied to promote the spread of the anesthetic and reduce intraocular pressure (IOP).

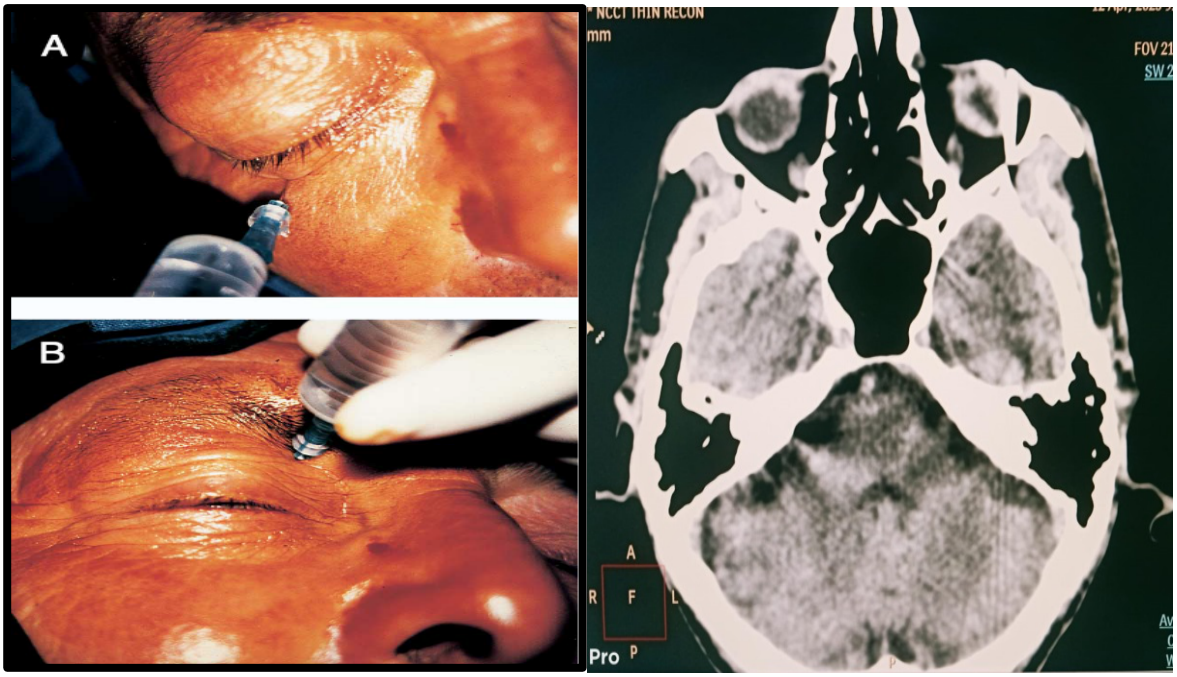

Figure 1: Conventional peribulbar injection: (A) inferior and temporal injection and (B) superior and nasal injection. Left showing CT guided peribulbur block.

Baseline parameters, including heart rate (HR), mean arterial pressure (MAP), oxygen saturation (SpO_2), respiratory rate (RR), intraocular pressure (IOP), and eyelid movement scores, were recorded in the preoperative room and monitored at five-minute intervals. IOP was measured using a Schiotz tonometer, and ocular movement was evaluated using a three-point scoring system across all four quadrants. Akinesia was assessed using a scoring system for eyelid movement, and sedation was measured using a subjective grading scale.

The adequacy of analgesia and akinesia was assessed 15 minutes after the block. Analgesia was deemed perfect if patients reported no pain, as assessed using a visual analogue scale during surgical manipulation. Akinesia was considered perfect when no ocular movement was observed in any direction. Throughout the surgery, HR, MAP, RR, and SpO_2 were monitored every five minutes. Postoperatively, patients were observed in a recovery ward for the return of ocular movement and sedation recovery. Vital parameters were recorded during this period. Patients were also provided with a pain assessment questionnaire to record the duration of analgesia and the time to first use of rescue analgesia. Statistical analysis was performed using Bartlett's χ^2 test followed by Kruskal-Wallis one-way ANOVA for intergroup comparisons. Paired Student's t-test was used for within-group comparisons. Results were expressed as mean ± SD, and a p-value of <0.05 was considered statistically significant. Post-study power analysis was conducted for anesthesia duration, akinesia, and analgesia.

Results

Table 1: Block Characteristics

Characteristic	Group A (Mean ± SD)	Group B (Mean ± SD)	Group C (Mean ± SD)
Onset of sensory anesthesia (min)	4.7 ± 2.1	3.7 ± 1.5	3.2 ± 1.2
Onset of motor blockade (min)	7.3 ± 2.6	4.2 ± 2.4	3.5 ± 1.2
Duration of analgesia (min)	187.6 ± 23.1	243.2 ± 27.0	341.3 ± 32.1

Table 2: Hemodynamic Parameters

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	Group C (Mean ± SD)
Heart Rate (bpm)	79.2 ± 5.2	73.7 ± 6.0	74.0 ± 6.1
MAP (mmHg)	105.1 ± 6.1	105.0 ± 6.11	105.3 ± 6.15
SpO2 (%)	98.4 ± 5.7	98.2 ± 5.4	98.0 ± 4.8

Table 3: Complications and Side Effects

Side Effect	Group A (N)	Group B (N)	Group C (N)
Nausea	4	1	1
Vomiting	1	1	0
Headache	4	1	1
Dizziness	5	3	2
Dry mouth	2	10	8

I have provided three summarized tables for your results (Table 1,2,3)

1. Block Characteristics: Includes the onset of sensory and motor blockade and the duration of analgesia across groups.
2. Hemodynamic Parameters: Summarizes heart rate, MAP, and SpO2 values for the groups with statistical comparisons.
3. Complications and Side Effects: Highlights the incidence of side effects like nausea, vomiting, headache, dizziness, and dry mouth.

Discussion

The increasing life expectancy attributed to advancements in medical diagnostic and therapeutic technologies has led to a significant focus on improving the quality of life. This shift has resulted in an increased number of patients seeking therapeutic and diagnostic procedures, including day-care cataract surgeries such as phacoemulsification [1]. These procedures often involve elderly patients with systemic diseases such as hypertension, diabetes, and cardiac conditions, making their perioperative management challenging [2]. Regional anesthesia, especially peribulbar block, has become the preferred method for such surgeries due to its safety and avoidance of complications associated with general anesthesia [3].

Peribulbar block, the most commonly used regional anesthesia for cataract surgeries, typically involves lignocaine and bupivacaine, both amide local anesthetics with favorable pharmacological profiles [4,5]. The addition of clonidine, an α-2 adrenergic

agonist, enhances the quality of the block by accelerating onset and prolonging analgesia while reducing the volume of local anesthetic required [6,7]. Clonidine achieves this by increasing potassium ion conductance, thereby potentiating the blockade of nerve fibers, and reducing systemic absorption through vasoconstriction [8]. In our randomized, double-blind study of 120 patients, we evaluated the efficacy of lignocaine and bupivacaine with and without clonidine in two doses (0.5 µg/kg and 1.0 µg/kg).

Group A received the standard mixture of lignocaine and bupivacaine, Group B included 0.5 µg/kg clonidine, and Group C included 1.0 µg/kg clonidine.

The addition of clonidine significantly reduced the onset time for sensory anesthesia and motor blockade, with mean onset times of 4.7 ± 2.1 minutes for Group A, 3.7 ± 1.5 minutes for Group B, and 3.2 ± 1.2 minutes for Group C [9].

Similarly, motor blockade onset was faster in Groups B and C, with durations of 4.2 ± 2.4 and 3.5 ± 1.2 minutes, compared to 7.3 ± 2.6 minutes in Group A [10]. The duration of analgesia was significantly prolonged with clonidine, measured at 187.6 ± 23.1 minutes in Group A, 243.2 ± 27.0 minutes in Group B, and 341.3 ± 32.1 minutes in Group C [11].

Similar findings were reported in previous studies, which demonstrated enhanced block characteristics with clonidine as an adjuvant to local anesthetics [12,13]. Additionally, the intraoperative visual analogue scale (VAS) scores were lower in Groups B and C, indicating better pain control and patient comfort [14].

Hemodynamic parameters, including heart rate and mean arterial pressure, showed slight elevations during the first 5 minutes post-block administration due to procedural discomfort, which normalized by 10–15 minutes, coinciding with the onset of sensory block.

These findings align with earlier studies where similar hemodynamic trends were reported [15,16]. Importantly, the addition of clonidine was associated with a mild sedative effect, leading to calmer and more composed patients during surgery, as reflected in improved sedation scores.

Intraocular pressure (IOP) reduction, a critical aspect for phacoemulsification surgeries, was significantly observed in Group C at 15 minutes post-block administration. This can be attributed to clonidine's α-2 agonist action, which reduces aqueous humor production and enhances drainage, contributing to decreased IOP [17].

The improved ocular akinesia and lid akinesia observed in Groups B and C further facilitated optimal surgical conditions. The addition of clonidine also reduced the requirement for supplemental anesthesia and minimized the side-effect profile.

While patients in Group A experienced higher incidences of nausea, headache, and dizziness, Groups B and C reported fewer adverse effects, with dry mouth being the most common, observed in 25% and 20% of patients, respectively [18]. This finding is consistent with previous reports that identified clonidine as a beneficial adjuvant for improving block quality with minimal side effects [19,20].

Conclusion

Overall, our study highlights the efficacy of clonidine in improving the quality of peribulbar block, enhancing patient comfort, and reducing complications during phacoemulsification cataract surgery.

The findings are in line with prior research and suggest that clonidine, particularly at 0.5 µg/kg, provides a favorable balance of efficacy and safety. Further research with larger sample sizes and diverse patient populations is warranted to validate these outcomes and optimize the use of clonidine in ophthalmic anesthesia.

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