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Original Research Article

The effect of hyaluronidase in peribulbar block during cataract surgery

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Abstract

Background: Peribulbar anaesthesia is the most popular choice for cataract surgeries. It provides globe akinesia, analgesia and muscle relaxation. The action of hyaluronidase was first described in 1936. Hyaluronidase is the most common additive to ocular anaesthesia. Hyaluronidase is an enzyme that enables the rapid onset of anaesthesia and akinesia.

Aim and Objective: To study the effect of hyaluronidase in peribulbar block during cataract surgery.

Materials and Methods: A prospective, randomized controlled study was done to assess the effect of hyaluronidase in peribulbar block during cataract surgery in the department of Ophthalmology in a tertiary care hospital of Haryana for a period of 1 month. Total 40 patients were included in the study. Patients were randomly divided into two group, in which one group taken as case and other group as control. In one group no hyaluronidase was added but in other group hyaluronidase was added in the peribulbar block. Ocular motility was assessed at 1, 5 and 10 minutes for successful block.

Results: Patients in both groups as 20 in each group, and there was no significant differences between the two groups in age and sex noted. Ocular motility score at 1 min for both groups was same. The p value comes out to be significant ($p < 0.05$) both at 5 minutes and at 10 minutes, showed the incidence of successful block in hyaluronidase group in which the score was <4 for achieving akinesia.

Conclusion: Hyaluronidase has the advantage of adding it to the peribulbar block as it enables the rapid onset of anesthesia and akinesia with lower drug volume.

Keywords: Cataract, Anaesthesia, Hyaluronidase, Akinesia, Peribulbar block.

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1. Introduction

Every year, about 26 million surgeries are done on the eyes, making cataract surgery the most popular eye procedure in the world.[1]

The use of local anaesthesia has made a big difference in the way people are sedated during cataract surgery. Techniques like peribulbar, retrobulbar, and sub-tenon anaesthesia are often used on patients who need longer surgeries or are more likely to have problems. General anaesthesia, on the other hand, is usually only given to people who won't cooperate, are very nervous, or are children.[2]

In order for a patient to cooperate during ophthalmic surgery with local anaesthesia, both a lack of movement and anaesthesia must be successful. This is to keep the surgeon in the best possible health. A lot of people choose peribulbar anaesthesia for eye surgeries because its reliable ability to achieve anaesthesia and akinesia.[3]

For normal cataract surgeries, local anaesthesia is often chosen. This is usually done through nerve blocks. This method blocks nerves in a way that can be undone, which relieves pain, stops the muscles from moving, and relaxes them without the usual side effects of general anaesthesia.[4]

The periocular area is filled with a mixture of 2% lignocaine , 0.5% bupivacaine and 50 IU of hyaluronidase per ml of 2% lignocaine to stop the nerves that are needed for a safe, quick, and effective local anaesthetic effect. There are different ways to give these injections, such as retrobulbar, peribulbar, and sub-tenon/conjunctival methods.[5]

Hyaluronidase is an enzyme that breaks down hyaluronic acid and chondroitin sulphate. This disrupts the extracellular

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matrix, which makes injection anaesthetics work better by allowing them to spread more easily.[6]

This enzyme works as a "spreading factor," making the injection solution more evenly distributed and the quality of the block better when used with local anaesthetics for eye procedures.[7]

Aim of the study was to assess impact of hyaluronidase on effectiveness of peribulbar blocks during the cataract surgery.

2. Materials and Methods

A prospective, randomized controlled study was carried out to assess the impact of hyaluronidase on peribulbar blocks during cataract surgery. This study involved 40 eyes and was conducted over the course of one month at the Department of Ophthalmology in a tertiary care centre in Haryana. Informed consent was obtained prior to the procedure.

2.1. Inclusion criteria

1. Patients with senile cataracts

2.2. Exclusion criteria

1. Patients with pre-existing extraocular movement restriction

2.3. Method

Twenty eyes in each groups was taken randomly, with 20 eyes in each. A standard 25mm 23-gauge needle was used to do a peribulbar block while the patient's eyes stayed in the primary position. A mix of 2% lignocaine and 0.5% bupivacaine was given to one group, and 2% lignocaine, 0.5% bupivcaine and 50 IU of hyaluronidase per ml of 2% lignocaine was given to the other group. Nine millilitres of the anaesthetic mixture were used in each block. Five millilitres were injected into the inferior-lateral quadrant, where the medial two-thirds and lateral one-third of the inferior orbital rim meet, and four millilitres were injected into the superior-medial quadrant. Once the anaesthetic had been injected, the eyes were massaged to help it spread and make the globe softer. There was only one surgeon who did all the surgeries.

After the injection and massage, movements of muscles outside the eye were checked to see how well the analgesics and akinesia worked. The lack of eye movements showed that the akinesia was working, and the time when the akinesia started were written down.

The patient's reaction while the superior rectus bridle suture was being put in was a reliable way to ensure that the analgesia worked.

A reliable sign of a good block was a slowing down of eye movement. It was decided how the superior rectus, inferior rectus, medial rectus, and lateral rectus muscles moved and given a score. Normal movement got a score of 2, reduced movement got a score of 1, and akinesia got a score of 0. The highest score that all four muscles could get was 8.

At 1, 5, and 10 minute intervals, eye movement was checked. A score of 4 or less meant that there were fewer movements, which was seen as a sign of a good block. If the block didn't work after 5 minutes, another 2 ml of the peribulbar block was given, and the total amount used for a good block was written down.

The operating surgeon was also asked to report any problems with the anaesthesia during the operation. These problems were written down on a surgeon's score card.

Table 1: Showing relation of both group with age and sex

	Group 1 No hyaluronidase	**Group 2 With hyaluronidase**
Age (yr)	72 (mean)	76(mean)
Male	14	12
female	6	8

Table 1 displays the distribution of patients into two groups: Group 1, consisting of 20 patients who did not receive hyaluronidase, and Group 2, comprising 20 patients who received hyaluronidase. The table illustrates the relationship between the groups in terms of age and sex, with no significant differences observed between them. In Group 1, the mean age was 72 years, while in Group 2, it was 76 years. Group 1 included 14 males and 6 females, whereas Group 2 comprised 12 males and 8 females. The p-value for the t-test comparing the mean ages of the two groups is 0.0, which indicates a significant difference in mean age between Group 1 and Group 2. In contrast, the p-value for the chi-square test examining the gender distribution between the two groups is approximately 0.74, suggesting that there is non-significant difference in gender distribution between groups.

Table 2 displays the distribution of patients according to their motility scores at 1 minute. The Chi-square analysis is used to assess the association between the groups based on the observed frequencies. The p-value associated with this Chi-square statistic is greater than our significance level, leading us to fail to reject the null hypothesis. This result suggests that there is no significant association between the group (hyaluronidase vs. no hyaluronidase) and the motility score distribution.

Table 2: Shows the number of patients in each group with a successful block (motility score) at 1 minute, with a p-value of 0.67

	Score <4 (%)	**Score >4 (%)**
Group 1	7 (35)	13 (65)
Group 2	9 (45)	11 (55)

Specifically, in Group 1 (no hyaluronidase), 7 patients had scores below 4, while 13 patients had scores of 4 or above. In Group 2 (with hyaluronidase), 9 patients had scores below 4, and 11 patients had scores of 4 or above.

Table 3 presents the distribution of patients according to their motility scores at 5 minutes. The Chi-square analysis indicates a significant result between groups, with a p-value<0.05. In Group 1 (no hyaluronidase), 10 patients experienced a successful block, while 10 patients had an unsuccessful block. Conversely, in Group 2 (with hyaluronidase), 18 patients achieved a successful block, and only 2 patients had an unsuccessful block.

Table 3: Displays the number of patients achieving a successful block at 5 minutes, with a p-value of less than 0.05

	Successful block (%)	Unsuccessful block (%)
Group 1	10 (50)	10 (50)
Group 2	18 (90)	2(10)

Table 4 displays the distribution of patients according to their motility scores at 10 minutes. The chi-square analysis indicates a significant result between groups, with a p-value<0.05. In Group 1 (no hyaluronidase), 12 patients had a successful block, while 10 patients had an unsuccessful block. In contrast, in Group 2 (with hyaluronidase), 20 patients achieved a successful block, and only 2 patients experienced an unsuccessful block.

Table 4: Shows the number of patients achieving a successful block at 10 minutes, with a p-value of less than 0.05

	Successful block (%)	Unsuccessful block (%)
Group 1	12(60)	8(40)
Group 2	20(100)	0

3. Discussion

Hyaluronic acid (HA) is a polymer made up of repeating disaccharide units. By breaking down into tetrasaccharides, it makes it easier for injected local anaesthetics to move through the interstitial areas.[8]

HA is renowned for its lubricating properties, which enhance the viscoelasticity of tissue fluids and contribute to the stabilization and hydration of soft connective tissues. Its chemical structure is made up of disaccharide units joined by 1,4 glycosidic bonds. Each disaccharide unit has N-acetyl-D-glucosamine (GlcNAc) and D-glucuronic acid (GlcUA) attached to it by 1, 3 glycosidic bonds.[9]

The administration of hyaluronidase results in a gradual decline in its activity over time, influenced by factors including dilution, diffusion, and deactivation. Deactivation is influenced by anti-hyaluronidase activity, which differs between subcutaneous tissue and plasma. Additionally, various drugs may impact the effectiveness of hyaluronidase in the body.[10]

The combination of hyaluronidase and local anaesthesia provides advantages such as a faster onset of anaesthesia and akinesia, along with decreased drug volumes. This combination may also help decrease intraocular pressure (IOP).[11]

While hyaluronidase is anticipated to speed up the onset of analgesia and akinesia, research indicates that omitting it does not adversely affect the value of the peribulbar block.[12,13]

Nerve diameter, anaesthetic solution pH, and injection sites are some of the variables that affect when anaesthesia begins to take effect. Alkaline conditions increase the proportion of the anesthetic in its base form, which is more permeable through nerve membranes. While hyaluronidase can make the local anesthetic solution more alkaline, potentially aiding in the rapid onset of akinesia and analgesia, its primary contribution may be more related to modifying the pH of the solution rather than disrupting tissue barriers.[14]

Our findings indicate that the combination of hyaluronidase with 2% lignocaine and 0.5% bupivacaine significantly enhances the speed of onset for the peribulbar block compared to using these anesthetics alone.

Age, sex, and mean axial length of the eye were all about the same in all three patient groups in a study by Mantovani C et al. There were 30 patients in Group 1, 31 patients in Group 2, and 29 patients in Group 3 because one patient was mistakenly put in the wrong group. Group 1 had a mean age of 73 years (range 46–91), Group 2 had a mean age of 71 years (range 54–88), and Group 3 had a mean age of 74 years (range 51–91). The number of men to women in Group 1 was 10:20, in Group 2 it was 15:16, and in Group 3 it was 12:17. As a whole, it took 7 minutes for Group 1, 6 minutes for Group 2, and 4 minutes for Group 3 to get enough anaesthesia (P=0.089). Also, the average scores for eye movement after 8 minutes were much lower in Group 3 than in Group 1.[15]

No significant correlation was seen between the groups concerning age and sex in our study. Each group comprised 20 patients, Group 1 having a mean age of 72 years and Group 2 mean age of 76 years. The male-to-female ratios were 14:6 in Group 1 and 12:8 in Group 2.

We compared motility score at 1, 5, and 10 minutes between the groups. At 1 minute, no significant difference in motility score (p=0.67) between two groups receiving the peribulbar block with hyaluronidase and the group without were seen. However, at 5 minutes, the group that received hyaluronidase had a significantly higher number of patients with a successful block. This trend continued at 10 minutes, where the motility scores were significantly better in the hyaluronidase group, with all patients achieving a successful block.

At 10 minutes, motility scores were recorded for both groups, revealing a significant difference. All patients in Group 2 (who received the peribulbar block with hyaluronidase) achieved a successful block.

In a related study conducted by Dempsey GA et al, the efficacy of hyaluronidase in peribulbar blocks was evaluated. The study included 200 patients, who were randomly assigned to one of three groups: Group 1 (50 patients) received a peribulbar block without hyaluronidase, Group 2 (75 patients) received a peribulbar block with 50 IU/ml of hyaluronidase, and Group 3 (75 patients) received a peribulbar block with 300 IU/ml of hyaluronidase. Motility scores were assessed at 1, 5, and 10 minutes across the groups. The findings indicated that hyaluronidase significantly improved the quality of the peribulbar block at both 5 and 10 minutes compared to the control group.[16]

The amount of hyaluronidase used for eye anaesthesia can be anywhere from 0.75 to 300 IU/ml. Even though there is a lot of variation, most studies have not found any big differences in how well ocular anaesthesia works. This suggests that there isn't a clear dose-response link between the amount of hyaluronidase and the quality of the peribulbar block.[16,17]

4. Limitations of the Study

The study was limited by its sample size, which might not be sufficient to detect to rare adverse effects or subtle differences in efficacy. Another include patients specific factors such as varying orbital anatomy, comorbidities and individual pain threshold could also influence outcome, which was not recorded in our study.

5. Conclusion

Hyaluronidase is frequently utilised as an additive in peribulbar blocks because it enhances tissue permeability and improves the distribution of local anaesthesia. This enzyme functions by breaking down and hydrolysing the glycosaminoglycan-rich ground substance that typically obstructs intercellular diffusion. Hyaluronidase specifically degrades the C1-C2 bonds between glucosamine and glucuronic acid, resulting in a quicker onset of both anaesthesia and akinesia when used in conjunction with a peribulbar block. Due to this effect, hyaluronidase is commonly known as the "spreading factor."

6. Source of Funding

None

7. Conflict of Interest

None.

8. Ethical

Ethical No.: IEC/Approval/2023/83.

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