INTRAOCULAR PRESSURE AFTER PHACOEMULSIFICATION USING HYDROXYPROPYL METHYLCELLULOSE AND SODIUM HYALURONATE AS VISCOELASTICS

Muhammad Waseem, Naeem Rustam, Qamar ul Islam

Eye Department, Combined Military Hospital, Peshawar.

Background: Phacoemulsification and intraocular lens (IOL) implantation has resulted in early visual rehabilitation, increased wound stability and improved refractive results. Viscoelastic substances (VES) are important adjuncts in this type of surgery. Use of VES in phacoemulsification can be associated with adverse effects, the most common and potentially dangerous of which is the transient rise in intraocular pressure (IOP) in post-operative period. To evaluate the effects of viscoelastic substances on post-operative IOP after phacoemulsification with implantation of intraocular lens, a cross-sectional comparative, prospective study was conducted in the department of Ophthalmology, Combined Military Hospital, Peshawar, Pakistan, from October 2003 to March 2004. **Methods:** One hundred patients were randomized into two groups of 50 each. Phacoemulsification with implantation of intraocular lens was performed in all the patients. 2% Hydroxypropyl Methylcellulose (HPMC) was used in one group and 1% Sodium Hyaluronate (NaHa) was used in the other group. IOP was measured pre-operatively as well as 24 hours and 7 days post-operatively. **Results:** There was no significant difference in the pre-operative intraocular pressure between the two groups (p=0.483). Twenty four hours after surgery, the mean IOP increased by 2.84±SD 2.12 mm Hg in 2% Hydroxypropyl Methylcellulose group and 4.54±2.07 mm Hg in 1% Sodium Hyaluronate group. The increase was significantly higher in 1% Sodium Hyaluronate group as compared to 2% Hydroxypropyl Methylcellulose group (p=0.003). Seven days after surgery the mean intraocular pressure returned to near pre-operative levels in both the groups. **Conclusion:** Sodium Hyaluronate causes significantly higher increase in intraocular pressure in early post-operative period after cataract surgery inspite of maximum aspiration of viscoelastic substance from the eye following phacoemulsification surgery.

Key Words: Intraocular pressure, Methylcellulose, Sodium Hyaluronate, Phacoemulsification, Viscoelastic substance.

INTRODUCTION

Phacoemulsification and IOL implantation has resulted in early visual rehabilitation, increased wound stability and improved refractive results. VES are important adjuncts in this type of surgery.

VES consists of large macromolecules that act as viscosurgical tools or soft instruments to move, manipulate or relocate tissue and exert a protective effect on ocular tissues during surgery.

An ideal VES possess certain important rheologic properties like viscosity, elasticity and pseudoplasticity. Viscosity makes a material protective and lubricating, while elasticity provides protection from vibration and other mechanical impacts. Pseudoplasticity causes the material to deform which allows safe manipulation of tissues. An ideal VES must be sterile, optically clear, non-inflammatory, dilutable, hydrophilic and biologically inert[1]. Based on their physical properties, VES can be classified into two groups: Cohesive and Dispersive[2,3]. Cohesive VES is high viscosity, high molecular weight substance like 1% NaHa, which contain long molecular chains that tend to entwine, making the entire solution move as a mass. They help in maintaining anterior chamber, displace and stabilize the tissues, and counterbalance the positive vitreous pressure encountered in surgery. Dispersive VES like 2% HPMC, has lower viscosity with shorter molecular chains that have less tendency to entangle. They have better adherence to the corneal endothelium, resulting in better protection of endothelium against fluid during phacoemulsification[2].

VES plays various important roles during phacoemulsification, including maintenance of anterior chamber (AC) facilitating capsulorhexis, protection of corneal endothelium, temponade of intraocular structures, protection of posterior capsule from sharp edge of broken nuclear fragments, and filling of capsular bag prior to IOL insertion[2].

Use of VES in phacoemulsification can be associated with adverse effects, the most common and potentially dangerous of which is the transient rise in IOP in post-operative period. The mechanism of VES related IOP elevation is thought to be clogging of the trabecular channels.[2,3]

The rise in IOP is most commonly occur between 4 to 7 hours post-operatively and often returns to normal within 24 to 48 hours[3]. The magnitude and duration of post-operative IOP elevation can be

reduced by meticulous irrigation of AC at the end of surgery.

In our setting, both 1% NaHa and 2% HPMC are being used. The purpose of this study was to evaluate the short-term effect of these two different VES on post-operative IOP.

MATERIAL AND METHODS

A cross-sectional, comparative, prospective study was carried out from October 2003 to March 2004 in the department of Ophthalmology, Combined Military Hospital, Peshawar, which is a tertiary care hospital.

The objectives of the study were to determine the rise in IOP during post-operative period after phacoemulsification with implantation of IOL using 2% HPMC and 1% NaHa and to compare them in terms of difference in frequency and severity of post-operative IOP rise.

The sampling was done on convenience basis. The subjects included in the study comprised civilians, army men and their families. One hundred patients met the inclusion criteria, and were registered for the study. The points considered for the inclusion criteria were patients with normal pre-operative IOP (11mmHg to 21mmHg), with immature senile cataract, ages between 50-80 years, and gonioscopically open angle (Shaffer's grade 4 and 3). Patients with history or evidence of previous intraocular surgery, glaucoma, intraocular inflammation, diabetes mellitus and hypertension were excluded from the study. Those who did not turn up for complete follow up were also excluded.

A comprehensive proforma was devised to register the patient's particulars. The group assignment and required recordings of IOP were endorsed for each patient. Same Ophthalmologist recorded all the measurements of IOP using same Goldmann applanation tonometer.

Patients with senile immature cataract reporting for phacoemulsification surgery with implantation of IOL were evaluated. A detailed slit lamp examination was done in each patient to look for any signs of intraocular inflammation or evidence of previous surgery. Gonioscopy and fundus examination was done to look for glaucoma. All patients were informed about the study in detail and written consent was obtained. Demographic data and group assignment of each patient was endorsed on the given proforma.

Two groups of 50 patients each were made by randomization. 2% HPMC (Picagel, Picaso Vision) was used in group I and 1% NaHa (Healon, Pharmacia & Upjohn) in group II. However, none of the persons involved in this study had any preference or commercial interest for any particular VES. The group assignment was masked to the Ophthalmologist measuring the IOP to eliminate any chance of bias towards a particular VES. However, no attempts were made to mask the randomization of VES from the operating surgeon due to the characteristic handling features of these agents.

Pre-operative baseline IOP was measured one day prior to surgery. No IOP lowering medicines were used pre-operatively. Before surgery, the pupil was dilated with 1% Tropicamide (Mydriacyl, Alcon) and 10% Phenylephrine (Isonefrine, Harvard) eye drops. All operations were performed by the same surgeon under facial block and peribulbar anesthesia, using injection 2% Lignocaine and 0.0005%Adrenaline (Xylocaine, Barrett Hodgson).

After disinfecting and draping the eye, a 3.2mm temporal limbal stab incision and nasal paracentesis incision were made and the AC was filled with the assigned VES. A capsulorhexis was created and hydrodissection was done using balanced salt solution (BSS, Alcon). After in- the-bag phacoemulsification of the nucleus using the stop-and-chop technique, the cortical matter was removed by automated irrigation/aspiration (I/A). The incision was enlarged to 5 mm and the capsular bag and AC were expanded with the assigned VES. A Phaco rigid, Polymethyl Methacrylate (PMMA) IOL (Rayner), whose optic was 5 x 6 mm in diameter, was implanted. The VES was aspirated thoroughly from the retrolental space, the capsule fornix, and the AC using I/A tip. Finally, the AC was rinsed before retracting the I/A tip. The tonus of the eye was restored to approximate physiological levels with BSS. One radial 10-0 nylon suture was used to close the incision. At the conclusion of the procedure, a subconjunctival injection of 0.5 ml Gentamycin (40 mg/ml) and 0.5 ml Dexamethasone (4 mg/ml) was given. Eye was padded after instilling 0.3% Norfloxacin (Chibroxine), and Maxitrol (0.1% Dexamethasone, 0.35% Neomycin and Polymyxin B sulphate 6000 units/ml, Alcon) eye drops and Fusidic acid (Fucithalmic, Leo) eye ointment.

The IOP was measured at 24 hours after surgery. Confounding factor of inflammation was duly considered. Post-operatively, Maxitrol (Alcon) and Chibroxine (MSD) eye drops were advised 4 times a day, starting the day after surgery and continuing for one month. All patients were seen again on 7th post-operative day and IOP was recorded on the given proforma.

Five patients from group I and 4 patients from group II were excluded from the study because they failed to report for follow-up. Analysis of the data was carried out using statistical package for social sciences (SPSS) version 10.0. Student't' test was used to compare the mean IOP of each group at each time interval. 't' test was also applied for comparison of results between the two groups. A p value < 0.05 was used as significance cut off point.

RESULTS

A total of 91 patients (51 males and 40 females) were eligible for analysis. Out of those, 45 (26 males and 19 females) were in group I (2% HPMC group) and 46 (25 males and 21 females) were in group II (1% NaHa group). Age spectrum was from 52 to 75 years in group I and from 57 to 77 years in group II. The age difference between the two groups was not statistically significant (p=0.208). Mean total operation time (including phacoemulsification time) was 26.73±4.38 minutes. Statistically, there was no significant differences in the mean operation time between the groups (p=0.402). The measurements of IOP are given in the Table 1&2. There was no significant 'between the groups' difference in pre-operative IOP (p=0.483).

No patient in either group had a pre-operative IOP greater than 21 mm Hg. Both groups experienced a statistically significant elevation in mean IOP at 24 hrs after surgery, over the pre-operative values (Table 2). On 7th day after surgery, mean IOP in both groups had returned to approximately pre-operative values. Moreover, the mean IOP values at 7th post-operative day were also comparable between the two groups (p=0.420). At the 7th post-operative day no patient in either group had an IOP greater than 21 mm Hg.

DISCUSSION

Several VES have become commercially available in the past two decades. Various commercial preparations of 2% HPMC and 1% NaHa are being widely used in small incision cataract surgery[5, 6].

An increase in IOP in early post-operative period (first 24 hrs) has become a major concern, since a large number of cataract surgeries are performed on an out-patient basis. The issue of post operative IOP spikes with VES use in cataract has long been contentious, with many conflicting reports and only few conclusive studies.[7-12]

Our findings indicated that in both groups, a significant elevation in IOP at 24 hrs post-operatively was followed by a decline to approximately pre-operative values by day 7. However, the mean IOP elevation at 24 hrs after surgery was significantly higher in 1% NaHa group as compared to 2% HPMC group. Moreover, 1% NaHa group had more cases of IOP spikes more than 25 mm Hg at 24 hrs after surgery as compared to other group.

One previous study reported a statistically significant higher IOP for 1% NaHa group than for 2% HPMC group at 24 hrs after small incision cataract surgery[13]. These results are comparable with our study.

Jurgens and co-authors evaluated the course of ocular hypertension with two different VES and three different surgical techniques. They reported a trend for higher IOP during first 24 hrs after surgery with high viscosity VES and with small-incision technique[14].

One of the study which compared Healon®5 (2.3% NaHa) and Healon® GV (1.4% NaHa) with Ocucoat® (2% HPMC) and Celoftal® (2% HPMC) in terms of influence on IOP after phacoemulsification, reported a non-significant increase in IOP at 24 hrs in all groups[15].

Kohnen and co-authors reported a greater mean IOP elevation with Healon GV than Healon at 24 hrs after suture less cataract surgery[16].

There have been studies on the effect of 2% HPMC and 1% NaHa on post-operative IOP after routine large incision extra-capsular cataract extraction(ECCE) with implantation of IOL[17,18,19]. However, these studies are difficult to compare and often contradictory, since the post-operative IOP varies inter-individually and with the surgical technique. Junejo and Laghari [20] reported that 1% NaHa group showed greater rise of post-operative IOP after ECCE with implantation of IOL as compared to 2% HPMC group in which the rise of IOP was not significant.

Table 1: Pre-operative and post-operative IOP after phacoemulsification using Hydroxypropyl Methylcellulose and Sodium Hyaluronate

TIME	MEAN IOP (mm Hg) ±SD (95% CI) 2% HPMC group (n = 45)	MEAN IOP (mm Hg) ±SD (95% CI) 1% NaHa Group (n = 46)	p value
Preoperative	14.09 ± 1.89 (13.53-14.65)	14.30 ± 2.00 (13.72-14.88)	0.483
Postoperative (24 Hours)	16.93 ± 2.61 (16.15-17.71)	18.83 ± 2.85 (17.99-19.67)	0.003*
Postoperative (7th Day)	14.38 ± 1.68 (13.88-14.88)	14.65 ± 1.62 (14.17-15.13)	0.420

* Statistically significant, SD = standard deviation, CI Confidence Interval

Table 2: Change in IOP from the baseline to 24 hrs and 7th post-operative day after using Hydroxypropyl Methylcellulose and Sodium Hyaluronate

Post Operative Time	Group I mean IOP change ± SD	p value	Group II mean IOP change ± SD	p value
• 24 Hours	2.84 ± 2.12	< 0.001*	4.54 ± 2.07	< 0.001*
• 7th day	0.29 ± 1.27	0.135	0.37 ± 1.42	0.084

* Statistically significant difference

In another study [21], causes of early post-operative ocular hypertension after ECCE and IOL implantation were evaluated. They reported that VES was found to be the main cause of post-operative IOP elevation. In order to reduce the incidence and severity of post-operative IOP elevation, various surgical techniques for complete removal of VES have been described[22, 23]. In our study every attempt was made to completely remove the VES from the AC as well as from retrolental space at the end of surgery. Assuming that equal and negligible amounts of VES were retained in all patients in our study, the difference in effect on post-operative IOP between two VES could be due to their different biophysical properties.

CONCLUSIONS

Our study revealed a slightly higher post-operative IOP elevation with 1% NaHa than 2%HPMC, probably as a result of greater molecular mass retention at the end of surgery. Surgeons should be familiar with the techniques to ensure optimal use and complete removal of VES at the end of surgery.

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Address for correspondence: Dr. Muhammad Waseem, FCPS (Ophthalmology), Head of the Department, Classified Eye Specialist, PNS Shifa, Naval Hospital Karachi. Tel: 021-48506538, 48507723, 0333-9119161
E-mail: mwkhan@brain.net.pk