DOI: https://doi.org/10.54393/pjhs.v3i07.401

PAKISTAN JOURNAL OF HEALTH SCIENCES
https://thejas.com.pk/index.php/pjhs
Volume 3, Issue 7 (December 2022)

Original Article

Raised Intraocular Pressure Following Phacoemulsification; A Comparative Study with Two Different Viscoelastic

Ahmed Jamal Khan[1], Maqbool-ur-Rehman[2], Awais Ashraf [3], Muhammad Sajid Khan[1], Ubaid Ullah[1] and Aeeza Malik[4*]

[1]Department of Ophthalmology, Hayatabad Medical Complex, Peshawar, Pakistan
[2]Department of Ophthalmology, Khyber Teaching Hospital, Peshawar, Pakistan
[3]Department of Ophthalmology, Multan Medical and Dental College, Multan, Pakistan
[4]Multan Medical and Dental College, Multan, Pakistan

ARTICLE INFO

Key Words:
Intraocular Pressure, Methylcellulose, Sodium Hyaluronate, Phacoemulsification, Viscoelastic Substance

How to Cite:
Jamal Khan, A. ., Rehman, M.- ur, Ashraf , A., Sajid Khan, M. ., Ullah, U. ., & Malik, A. (2022). Raised Intraocular Pressure Following Phacoemulsification; A Comparative Study with Two Different Viscoelastic: Raised Intraocular Pressure Following Phacoemulsification. Pakistan Journal of Health Sciences, 3(07). https://doi.org/10.54393/pjhs.v3i07.401

***Corresponding Author:**
Aeeza Malik
Multan Medical and Dental College, Multan, Pakistan
aeezamalik@gmail.com

Received Date: 3rd December, 2022
Acceptance Date: 23rd December, 2022
Published Date: 31st December, 2022

ABSTRACT

The new modalities in surgical phacoemulsification techniques are intended to restore the visual acuity and have minimized postoperative astigmatism. **Objective:** To evaluate the difference in the raised intraocular pressure after phacoemulsification and insertion of an intraocular lens using 2% hydroxymethyl cellulose and 1% sodium hyaluronate as viscoelastic. **Methods:** This group comparative study was performed in the Department of Ophthalmology, Khyber Teaching Hospital, Peshawar for six months. A thorough slit lamp examination was executed to confirm intraocular inflammation or proof of prior intraocular surgery. For glaucoma, Gonioscopy was performed along with proper fundus examination. Patients in Group 1 received 2% Hydroxymethyl Cellulose while in Group 2 patients received 1% Sodium Hyaluronate as viscoelastic. No pressure lowering drug was used and mean intraocular pressure was calculated using Goldman Applanation Tonometer. Intraocular pressure was measured preoperatively and then after 6, 12 and 24 hours and then after one week of surgery. **Results:** In Group 1, mean age was 65 ± 8.5 and mean Pre Op IOP was 13.1 ± 2.1. Mean Postop IOPs were 13.8, 14.2, 15.1 and 17.5 at 6, 12, and 24 hours and after 1 week respectively. In Group 2, mean age was 62.7 ± 8.3 and mean Preop IOP was 13.2 ± 2.3. Mean Postop IOPs were 13.5, 13.9, 15.1 and 15.9 at 6, 12, and 24 hours and after 1 week respectively. **Conclusions:** Mean intraocular pressure rise was significantly greater at one week after phacoemulsification and insertion of an intraocular lens using 2% hydroxymethyl cellulose as viscoelastic.

INTRODUCTION

Phacoemulsification is considered to be the most effective procedure for visual rehabilitation and recovery; it usually involves small incisions of 2mm in length, rather than sutures or stitches. It was introduced first by Kelman in 1967 in order to deal with cataract management. Phacoemulsification is the emulsification of the eye's natural lens; it is a very advanced and effective technique for acquiring safety and success during cataract surgery [1-3]. Intraocular Pressure (IOP) is the pressure of the fluid in an eye. The flow of the liquid (aqueous humor) into the anterior and posterior chambers is responsible for the shape of the eye along with other visual properties. Its main tasks are that is transportation of neurotransmitters, provide strength/nutrition to avascular lens and cornea, helps in the maintenance of the ocular structure, etc [4, 5]. Viscoelastic aka Ophthalmic Viscosurgical Devices (OVDs), thick sticky stuff helps during the cataract surgery and makes phacoemulsification safe and achievable, damage to the eye is usually prevented during cataract surgery with the help of Viscoelastic Substances (VES) by replacing aqueous with thick VES. A perfect VES must be free from any kind of microorganisms, hydrophilic, ability to be diluted, well clear, and do not possess any inflammatory properties [6]. More importantly, VES must contain some

DOI: https://doi.org/10.54393/pjhs.v3i07.401

very critical traits like elasticity, viscosity, and pseudo-plasticity for preventing any damage to the anterior chamber. The property of elasticity prevents any damage to the eye as a result of vibration and the shock occurrence by operating the device, viscosity helps in lubrication and safeguarding, and pseudo-plasticity assists in disfiguring of material, which ensures safe control of the tissues [7]. The role of VES in performing phacoemulsification can never be neglected as it prevents corneal endothelial from any damage, keep away broken fragments by causing damage to the posterior capsule, during Continuous Curvilinear Capsulorhexis (CCC) VES plays a vital role in the maintenance of anterior chamber, protecting intraocular tamponade and before Intraocular Lens IOL implant, capsular bag filling. VES is either Cohesive or Dispersive, 1% Sodium Hyaluronate (SH) falls into the category of cohesive VES as its weight of molecules and viscosity is high, which makes it a mass alike giving it the properties regarding tissues stabilizing, displacement, and to sustain the anterior chamber [8, 9]. Dispersive VES includes 2 % Hydroxymethyl Cellulose (HC), which showed promising results in phacoemulsification for endothelium safety against flowing substance, moreover, 2% HC has less viscosity, little ability to intertwine, and its chain of molecules are small in size 8. Elevation in IOP, after the procedure, is noted to be a harmful effect as a result of VES usage in phacoemulsification. The adverse effect of a raise in IOP was commonly observed after few hours of the procedure and comes back to normal after 48 hours maximum [10]. The development of new surgical phacoemulsification techniques is aimed at restoring visual acuity (VA) in order to secure a fast return to normal social life and work. Small incision phacoemulsification procedures have minimized postoperative astigmatism and furthers comparative researches in this part of ophthalmology are highly needed. Therefore, this study was planned with an objective to evaluate the difference in the raised intraocular pressure after phacoemulsification and insertion of an intraocular lens using 2% hydroxymethyl cellulose and 1% sodium hyaluronate as viscoelastic

METHODS

This group comparative study was carried out in Ophthalmology Ward B and the Out Patient Department (OPD) of Khyber Teaching Hospital, Peshawar for six months (November 2020 to May 2021) after taking approval from Hospital's Ethical Committee (IREB No. 002/ADR/KMC). Written consent was taken from the patients participating in the study after informing them about the study. A total of 64 subjects fulfilling the inclusion criteria were selected for the study on the basis of random sampling using simple random number table. The inclusion criteria was defined as patients having age between 45 to 70 years, immature senile cataract having normal IOP of 11mm Hg to 21 mm Hg and gonio scopically open angle (Shaffer's grade III and IV angles). Patients having history of earlier intraocular surgery, diabetes, intraocular inflammation, glaucoma, hypertension and traumatic cataract were disqualified from the study. Through the OPD, patients were analyzed for phacoemulsification and insertion of an IOL as per the sign of a senile small cataract. A structured and validated proforma was employed to record the details of the patients. A thorough slit lamp examination was executed to confirm intraocular inflammation or proof of prior intraocular surgery. For glaucoma, Gonioscopy was performed along with proper fundus examination. Patients were later randomly allocated into 2 groups through lottery method. Group 1 received 1% sodium hyaluronate as viscoelastic. Group 2 received 2% hydroxymethyl cellulose as viscoelastic. All the interventions were performed by the single trained and reliable ophthalmologist. No pressure lowering drug was used pre operatively and mean IOP was calculated using Goldman Applanation Tonometer. IOP was measured preoperatively and then after 6, 12 and 24 hours and then after one week of surgery. Data were analyzed using SPSS version 20.0. For categorical data frequencies and percentages were used. Mean and standard deviation were calculated for continuous data. Student t test was performed for mean IOP comparisons of each group at 1st week. P value >0.05 was considered statistically significant.

RESULTS

The mean age of the patients in Group 1 was 62.5 ± 8.5 and in Group 2 was 62.7 ± 8.3. Group 1 have n=10 (31.25%) of the patients between age 45-60 years while, 22 (68.75%) of the patients in the age group of 61-70 years. In Group 2, n=10 (31.25%) of the patients in 45-60 years of age whereas, 22 (68.75%) of patients were of age between 61-70 years. In Group 1, 20 (62.5%) patients were males and 12 (37.5%) patients were recorded as females whereas, in Group 2, 20 (62.5%) patients were males and 12 (37.5%) patients were females. Significant difference in the rise of IOP has been observed between the two groups. Mean and SD for Pre and Post IOP at different time intervals is demonstrated (Table 1).

Groups	Preop IOP	Postop IOP at 6 Hours	Postop IOP at 12 Hours	Postop IOP at 24 Hours	Postop IOP at one week
Group 1	13.1 ± 2.1	13.8 ± 2.2	14.2 ± 2.3	15.9 ± 2.2	17.5 ± 2.4
Group 2	13.2 ± 2.3	13.5 ± 2.3	13.9 ± 2.4	15.1 ± 2.5	15.9 ± 2.1
Total	13.5 ± 2.2	13.7 ± 2.3	13.9 ± 2.2	15.6 ± 2.5	17.2 ± 2.5

Table 1: Mean and SD for Pre and Post IOP at different time intervals
Group 1= 2% hydroxymethyl cellulose

DOI: https://doi.org/10.54393/pjhs.v3i07.401

Group 2 = 1% sodium hyaluronate
Stratification of Mean IOP at one week with age and gender are illustrated (Table 2 and 3).

Mean IOP	Group 1 (n=32)	Group 2 (n=32)	p-value
45 to 60 yrs	15.6 ± 2.2	17.4 ± 2.1	0.00001
61 to 70 yrs	15.9 ± 2.5	17.2 ± 2.3	0.00001
Total	32 (100%)	32 (100%)	64 (100%)

Table 2: Stratification of Mean IOP with Age
Group 1 = 2% hydroxymethyl cellulose
Group 2 = 1% sodium hyaluronate

Mean IOP	Group A (n=32)	Group B (n=32)	p-value
Male	15.6 ± 2.1	17.4 ± 2.2	0.00001
Female	15.9 ± 2.2	17.2 ± 2.4	0.00001
Total	32 (100%)	32 (100%)	64 (100%)

Table 3: Stratification of Mean IOP with Gender
Group 1 = 2% hydroxymethyl cellulose
Group 2 = 1% sodium hyaluronate

DISCUSSION

This study was aimed to evaluate the difference in the raised intraocular pressure after phacoemulsification and insertion of an intraocular lens using 2% hydroxymethyl cellulose and 1% sodium hyaluronate as viscoelastic and found significantly greater mean intraocular pressure at one week after using 2% HC in comparison to 1% SH as viscoelastic and so the application of such viscoelastic substances like HC may improve the eminence of anterior chamber eye surgery. The use of materials such as viscoelastic in cataract surgery were for the first time described in 1972 [11,12]. Viscoelastics or ophthalmic viscosurgical devices (OVDs), enable the cataract operation by preserving the deepness and the overall anatomy of the anterior chamber of eye. This gives the surgeon enough workspace along with the provision of viscous barrier which shelters the delicate and febrile corneal endothelium. Malvankar-Mehta *et al.*, found that damage to the corneal endothelium was mainly because of the surgical instruments, the cataractous lens debris along with the intraocular lens and injector during the procedure of insertion [13]. Kalode *et al.*, found in his study high IOP was one of the commonest post-operative complications after the procedure of phacoemulsification [14]. The initial post-operative rise in IOP was predominantly associated with the obstruction of trabecular meshwork which is actually because of the remains of OVD in the eye [15]. HPMC are the units of less viscous OVDs which do not stick to each other and therefore are highly dispersive. This dispersive property of low-viscosity OVDs was relatively difficult to eliminate from eye completely [16]. Bardoloi *et al.*, study also reported that retained viscoelastic and susceptibilities like trabecular trauma or unidentified or neglected glaucoma were the foremost reasons behind the IOP increase post-operatively [17, 18]. Furthermore, Payal *et al.*, study related the consequence concerning HC and SH and on IOP and found significant rise in IOP in SH [19]. Another Lin *et al.*, study also described the escalation in IOP from 55 to 60mm of Hg when the anterior chamber was being injected with SH as it obstructs the trabecular meshwork [20]. Numerous surgical procedures were therefore carried out with the aim to completely remove the OVD, predominantly from the backside of the IOL, but unfortunately none of them succeeded in avoiding the development of postoperative IOP rise [21]. In present research, a comparison was been made between the insertion of intraocular lens employing 2% HC and 1% SH as viscoelastic and found significant rise in IOP when 2% HC was used. These results are better in comparison to another similar study related to IOL implantation by means of hydro implantation [22, 23]. One more study has compared the hydroimplantation and viscoimplantation and concluded the same depth of capsular bag and the anterior camera. Watanabe *et al.*, observed no difference in corneal edema one day one post operatively and less time of 40 to 60 seconds was required in lens implantation of hydroimplantation group in contrast to 2.4 to 4 minutes in viscoimplantation group [26]. Moreover, when attempts were made to completely remove the viscoelastic, it was frequently impossible and also increased the duration of operation. The in return rise in postoperative IOP levels may also result in injury to the optic nerve leading to ischemia exclusively in patients with glaucoma [24]. Even though the viscoelastic element present in front of IOL may straightforwardly be aspirated by means of irrigation hand piece, still there was a chance of some left over material in the capsule of the lens mainly at back of the IOL. Well-adjusted salt solution has reported to be effective in decreasing the frequency of endophthalmitis along with toxic anterior segment syndrome. This solution works by washing the capsule of interior lens [25, 26].

CONCLUSIONS

Mean intraocular pressure rise was significantly greater at one week after phacoemulsification with implantation of intraocular lens using 2% Hydroxymethyl cellulose in comparison as viscoelastic.

Conflicts of Interest

The authors declare no conflict of interest.

Source of Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Astbury NJ. The Royal College of Ophthalmologists Cataract Surgery Guidelines: what can patients see with their operated eye during cataract surgery?.

DOI: https://doi.org/10.54393/pjhs.v3i07.401

Eye. 2003 Mar; 17(2): 285-6. doi: 10.1038/sj.eye.6700282

[2] Singh K, Misbah A, Saluja P, Singh AK. Review of manual small-incision cataract surgery. Indian Journal of Ophthalmology. 2017 Dec; 65(12): 1281-88. doi: 10.4103/ijo.IJO_863_17

[3] Asena BS. Visual and refractive outcomes, spectacle independence, and visual disturbances after cataract or refractive lens exchange surgery: comparison of 2 trifocal intraocular lenses. Journal of Cataract and Refractive Surgery. 2019 Nov; 45(11): 1539-46. doi: 10.1016/j.jcrs.2019.06.005

[4] Remington LA and Goodwin D. Clinical Anatomy and Physiology of the Visual System E-Book. Elsevier Health Sciences; 2021 Jun 25.

[5] Toris CB, Gagrani M, Ghate D. Current methods and new approaches to assess aqueous humor dynamics. Expert Review of Ophthalmology. 2021 May; 16(3): 139-60. doi: 10.1080/17469899.2021.1902308

[6] Mahsud H, Iqbal S, Khalid K, Khan MD, Ullah H. Comparison of effect of sodium hyaluronate and hydroxy propyl methylcellulose on intraocular pressure after cataract surgery. Gomal Journal of Medical Sciences. 2015 Mar;13(1): 1-4.

[7] Özcura F and Çevik S. Hydroimplantation versus viscoimplantation: comparison of intraocular lens implantation with and without ophthalmic viscoelastic device in phacoemulsification. Romanian Journal of Ophthalmology. 2018 Oct; 62(4): 282-7. doi: 10.22336/rjo.2018.43

[8] Van Ooteghem MM. Formulation of ophthalmic solutions and suspensions. Problems and advantages. In Biopharmaceutics of ocular drug delivery. CRC Press. 2019 Aug: 27-42.

[9] Yildirim TM, Auffarth GU, Son HS, Khoramnia R, Munro DJ, Merz PR. Dispersive viscosurgical devices demonstrate greater efficacy in protecting corneal endothelium in vitro. BMJ Open Ophthalmology. 2019 Feb; 4(1):e000227. doi: 10.1136/ bmjophth-2018-000227

[10] Reddy JC, Vaddavalli PK, Sharma N, Sachdev MS, Rajashekar YL, Sinha R, *et al*. A new normal with cataract surgery during COVID-19 pandemic. Indian Journal of Ophthalmology. 2020 Jul; 68(7): 1269-76. doi: 10.4103/ijo.IJO_1528_20

[11] Storr-Paulsen A, Nørregaard JC, Farik G, Tårnhøj J. The influence of viscoelastic substances on the corneal endothelial cell population during cataract surgery: a prospective study of cohesive and dispersive viscoelastics. Acta Ophthalmologica Scandinavica. 2007 Mar; 85(2): 183-7. doi: 10.1111/j.1600-0420.2006.00784.x

[12] Brogan K, Diaper CJ, Rotchford AP. Cataract surgery refractive outcomes: representative standards in a National Health Service setting. British Journal of Ophthalmology. 2019 Apr; 103(4): 539-43. doi: 10.1136/bjophthalmol-2018-312209

[13] Malvankar-Mehta MS, Fu A, Subramanian Y, Hutnik C. Impact of ophthalmic viscosurgical devices in cataract surgery. Journal of Ophthalmology. 2020 Oct; 2020. doi: 10.1155/2020/7801093

[14] Kalode VB and Sune P. Comparative study of safety and efficacy of dispersive versus cohesive ophthalmic viscosurgical devices in cataract surgery after phacoemulsification. Journal of Datta Meghe Institute of Medical Sciences University. 2020 Oct; 15(4):555-64. doi: 10.4103/jdmimsu.jdmimsu_239_20

[15] Wijesinghe HK, Puthuran GV, Ramulu PY, Ponnat AK, Reddy MM, Mani I, *et al*. Intraocular Pressure Control Following Phacoemulsification in Eyes with Pre-existing Aurolab Aqueous Drainage Implant. Journal of Glaucoma. 2022 Jun; 31(6): 456-61. doi: 10.1097/IJG.0000000000001946

[16] Kelkar A, Kelkar J, Mehta H, Amoaku W. Cataract surgery in diabetes mellitus: a systematic review. Indian Journal of Ophthalmology. 2018 Oct; 66(10):1401-10. doi: 10.4103/ijo.IJO_1158_17

[17] Gerberich AJ and Ipema HJ. A primer on ocular viscosurgical devices. American Journal of Health-System Pharmacy. 2021 Nov; 78(22): 2020-32. doi: 10.1093/ajhp/zxab228

[18] 18.Bardoloi N, Sarkar S, Pilania A, Das H. Pure phaco: phacoemulsification without ophthalmic viscosurgical devices. Journal of Cataract and Refractive Surgery. 2020 Feb; 46(2):174-8. doi: 10.1097/j.jcrs.0000000000000054

[19] 19.Payal AR, Sola-Del Valle D, Gonzalez-Gonzalez LA, Cakiner-Egilmez T, Chomsky AS, Vollman DE, *et al*. American Society of Anesthesiologists classification in cataract surgery: results from the ophthalmic surgery outcomes data project. Journal of Cataract and Refractive Surgery. 2016 Jul; 42(7): 972-82. doi: 10.1016/j.jcrs.2016.04.032

[20] 20. Lin CC, Rose-Nussbaumer JR, Al-Mohtaseb ZN, Pantanelli SM, Steigleman III WA, Hatch KM, *et al*. Femtosecond Laser-Assisted Cataract Surgery: A Report by the American Academy of Ophthalmology. Ophthalmology. 2022 May; 129(8): 946-54. doi: 10.1016/j.ophtha.2022.04.003

[21] 21.Adamus G, Champaigne R, Yang S. Occurrence of major anti-retinal autoantibodies associated with paraneoplastic autoimmune retinopathy. Clinical Immunology. 2020 Jan; 210: 108317. doi: 10.1016/j.clim.2019.108317

DOI: https://doi.org/10.54393/pjhs.v3i07.401

[22] Borkenstein AF, Borkenstein EM, Malyugin B. Ophthalmic Viscosurgical Devices (OVDs) in Challenging Cases: a Review. Ophthalmology and Therapy. 2021 Dec; 10(4): 831-43. doi: 10.1007/s40123-021-00403-9

[23] Murueta-Goyena A and Canadas P. Visual outcomes and management after corneal refractive surgery: A review. Journal of Optometry. 2018 Apr; 11(2): 121-9. doi: 10.1016/j.optom.2017.09.002

[24] Watanabe I, Suzuki K, Nagata M, Matsushima H. Clinical Functionality of Dispersive OVDs: Improvement of One of the Properties of 3% Hyaluronic Acid and 4% Chondroitin Sulfate Combination. Yakugaku Zasshi: Journal of the Pharmaceutical Society of Japan. 2022 Jan; 142(4): 401-11. doi: 10.1248/yakushi.21-00208

[25] Brandsdorfer A and Kang JJ. Improving accuracy for intraocular lens selection in cataract surgery. Current Opinion in Ophthalmology. 2018 Jul; 29(4): 323-7. doi: 10.1097/ICU.0000000000000493

[26] Verma L, Agarwal A, Dave VP, Honavar SG, Majji AB, Lall A, *et al*. All India Ophthalmological Society (AIOS) Task Force guidelines to prevent intraocular infections and cluster outbreaks after cataract surgery. Indian Journal of Ophthalmology. 2022 Feb; 70(2): 362-8. doi: 10.4103/ijo.IJO_94_22