ECRONICON OPEN ACCESS

EC OPHTHALMOLOGY
Research Article

Comparison of the Effect of 1.5% Polyacrylamide and 2% Hydroxypropyl Methylcellulose on Postopearatıve Intraocular Pressure Following Cataract Surgery

Tevfik Ogurel*, Reyhan Ogurel and Zafer Onaran

Department of Ophthalmology, Kirikkale University, Turkey

***Corresponding Author**: Tevfik Ogurel, Department of Ophthalmology, Kirikkale University, Turkey.

Received: October 20, 2017; **Published:** November 14, 2017

Abstract

Objective: To compare the effects of polyacrylamide and hydroxypropyl methylcellulose on postoperative intraocular pressure (IOP) elevation.

Material and Methods: This prospective study comprised 80 eyes of 72 consecutive patients who underwent cataract surgery and implantation of foldable intraocular lens. Each eye was assigned to either group 1 or group 2. Polyacrylamide was used in group 1 and hydroxypropyl methylcellulose was used in group 2. The viscoelastic material was aspirated using bimanual irrigation/aspiration tip in both groups. Preoperative and postoperative examinations (6 and 24 hours) included surgery time, intraocular pressure and central corneal thickness.

Results: Mean age for the group 1 was 68,37 ± 6,75 years and 70,55 ± 6,25 years for group 2. There was no statistically significant difference when mean preoperative IOP was compared between the two groups. (p = 0,556). In group 1, the mean IOP did not increase significantly at 6th and 24th hours and 1th month after surgery in comparison to preoperative measurements (p > 0,05) In group 2, the mean IOP increased significantly at 6th hours when compared with group 1 and preoperative measurements (p < 0,001) and returned to baseline levels at 24th hours and 1th month postoperatively (p > 0,05). There was no significant difference between surgery time and central corneal thickness (p > 0,05).

Conclusion: These findings indicate that Polyacrylamide doesn't cause a significantly higher IOP increase postoperatively and it seems more safely when compared with hydroxypropyl methylcellulose.

Keywords: *Intraocular Pressure; Polyacrylamide; Hydroxypropyl Methylcellulose; Cataract Surgery*

Introductıon

Ophthalmic viscosurgical devices (OVD) are one of the most important complementary of the modern cataract surgery. Although the viscoelastics have many benefits in ocular surgery, they may cause some side effects like postoperative intraocular pressure elevation and inflammation [1,2]. Therefore, the physical and chemical properties of each agent such as cohesivity, elasticity and dispersivity may reduce or increase the risk of these complications. Initially most of the viscoelastic was composed of sodium hyaluronate but today there are many viscoelastics which are made from different components such as chondroitin sulfate, hydroxypropyl methylcellulose (HPMC) and polyacrylamide [3].

Espindol., *et al*. compared Discovisc (4% chondroitin sulfate/1.65% sodium hyaluronate) and 2% HPMC in fellow eyes and found that discovisc (4% sodium chondroitin sulfate/1.65% sodium hyaluronate) was more efficient than 2% HPMC in cataract surgery and there were no statistically significant differences for central corneal thickness or intraocular pressure [4]. In another study, Modi., *et al*. evaluated efficacy of discovisc (4% chondroitin sulfate/1.65% sodium hyaluronate) and Healon (1% sodium hyaluronate) and found that both viscoelastic had similar outcomes for IOP and endothelial cell loss [5].

There are few studies with 4% polyacrylamide (Orcolon, Optical Radiation Co, USA), which was used during 1990s, comparing it with sodium hyaluronate to assess the effect of both viscoelastics on postoperative IOP [6,7]. In these studies, it was found that 4% polyacrylamide did not cause any side effects such as corneal edema, iritis, endothelial cell damage, except for a sustained increase in IOP when used in cataract surgery.

In this study, we compared 2% HPMC and 1.5% polyacrylamide in terms of IOP elevation in cataract surgery.

Materıals and Methods

This prospective randomized study comprised 80 eyes of 72 patients with bilateral age-related cataract scheduled for phacoemulsification cataract surgery and implantation of foldable intraocular lens. The research confirmed by Institutional Review Board. All patients gave written informed consent before their participation.

Exclusion criteria were ocular trauma, previous ocular surgery, ocular hypertension and glaucoma. Two groups were selected. Polyacrylamide (Medilon, Mediphacos, Brazil) was used in group 1, consisting of 40 eyes, and HPMC (Eyevisc, Biotech, India) was used in group 2 consisting of 40 eyes. Forty-two patients were female, and 30 patients were male. Pre-operative baseline IOP was measured using Goldmann applanation tonometry the day before the surgery. Pre-operative and postoperative (1st month) central corneal thickness (CCT), anterior and posterior segment examination and surgery time were recorded. All patients were operated by the same surgeon (Ogurel T). Prior to the surgery, the pupil was dilated with topical cyclopentolate, tropicamide and phenylephrine eye drops.

In both groups, two side-port and a main temporal incision were performed in all eyes. Following injection of viscoelastic (1,5% polyacrylamide in group 1 and 2% HPMC in group 2, continuous curvilinear capsulorhexis, hydrodissection, phacoemulsification of the nucleus and cortex aspiration were performed. The capsular bag was expanded with assigned viscoelastic agent and foldable acrylic intraocular lens was implanted into the capsular bag in all eyes. The viscoelastic material was aspirated from the anterior chamber, the capsule fornix and the retrolental space using bimanual irrigation/ aspiration tip in both groups. Finally, all corneal incisions were hydrated. Posterior capsule rupture did not occur in any eyes. No topical anti-glaucomatous agent was dropped immediately after the surgery in any patients.

All patients were treated with prednisolone acetate and moxifloxacin hydrochloride eyedrops five times after surgery. IOP was measured at 6th and 24th hours and 1st month after the surgery in both groups by Goldmann applanation tonometry.

Statistical analysis was done by SSPS statistical software (SPSS for windows 16.0, Inc., Chicago, USA). Group comparisons were made with paired -tests. A value less than 0.05 was defined statistically significant.

Results

Eighty eyes from 72 patients (27 men [33.7%] and 43 women [66.3%]) were enrolled in this study. The mean age of the patients in group 1 was 68,37 ± 6,75 years and 70, 55 ± 6,25 years in group 2. Out of those, 36 (23 females and 12 males) were in group 1 and 36 (21 females and 15 males) were in group 2. The difference between the two groups was not statistically significant in terms of age and gender (p = 0,186). Also, no significant difference was observed between groups regarding the mean surgery time (P = 0,458, Table 1).

Variable	Group 1 (Polyacrylamide) Mean ± SD	Group 2 (HPMC) Mean ± SD	p-value
Age	68,37 ± 6,75	70,55 ± 6,25	0,623
Gender (M/F)	12/23	15/21	0,514
Surgery Time min)	11,36 ± 3,18	12,46 ± 4,12	0,358

Table 1: *Demographic characteristics of two groups.*

The mean preoperative, postoperative 6th hours and 24th hours and 1th month IOP in group 1 were 15,6 ± 1.8 mmHg, 16,4 ± 1,1 mmHg, 15,8 ± 1,6 mmHg and 15,3 ± 1,7, respectively and 15,9 ± 1,8 mmHg, 22,9 ± 3,2 mmHg, 16,4 ± 1,7 mmHg and 16.1 ± 1,4 respectively in group 2. There was no statistically significant difference when mean preoperative IOPs were compared between the two study groups (p = 0,549). Table 2 shows the comparison of mean IOP elevation in each group.

Variable	Group 1 (Polyacrylamide) Mean ± SD	Group 2 (HPMC) Mean ± SD	p-value
Intraocular Pressure (mmHg)			
Preoperative	15,6 ± 1,8	15,9 ± 1,8	0,549
Postoperative			
6 hours	16,4 ± 1,1	22,9 ± 3,3	< 0,001
24 hours	15,8 ± 1,6	16,4 ± 1,7	0,104
1 month	15,3 ± 1,7	16.1 ± 1,4	0,271
Central Cornel Thickness (µm)			
Preoperative	535.7 ± 33.2	536.1 ± 34.8	0,724
Postoperative			
1 month	543.1 ± 36.6	541.6 ± 39.3	0,924

Table 2: *Primary outcome variables (Polyacrylamide versus HPMC).*

In group 1, the mean IOP did not increase significantly at 6th, 24th hours and 1st month after surgery when compared with preoperative measurements (p = 0,127, p = 0,675 and p = 0,423 respectively). In group 2, the mean IOP increased significantly at 6th hours after cataract surgery when compared with group1 and preoperative measurements (p < 0,001) and returned to baseline levels at 24h hours postoperatively (p = 0.07, p = 0,237).

In group 1; 4 (10%) eyes had an IOP increase of 5 mmHg or more, in group 2; 28 (70%) eyes had the same amount of IOP increase postoperatively. IOP values returned baseline level after 1 month in two groups.

The mean preoperative CCT was 535.7 ± 33.2 µm in the Polyacrylamide group 536.1 ± 34.8 µm in the HPMC group (p= 0.724). The mean postoperative CCT level at 1st month was 543.1 ± 36.6 µm in the polyacrylamide group and 541.6 ± 39.3 µm in the HPMC group. No statistically significant difference was found between the OVDs at any point (p > 0.05, Table 2).

No eyes experienced intraoperative or postoperative complications.

Discussion and Conclusion

The use of viscosurgical devices is the most preferred technique in modern anterior segment surgery. All OVDs are used to space maintenance for safe manipulation, protection of ocular tissue and facilitate intraocular lens implantation and capsulorhexis during the surgery [8-10]. In addition, they are used in complications of cataract surgery such as to prevent prolapsus of vitreous gel to the anterior chamber or balance pressure between the anterior and posterior segment of the eye when posterior capsule rupture. The ideal viscoelastic agent should be transparent, water-insoluble, viscous enough, cohesive enough, easily injected, protect ocular tissues from physical and chemical trauma, have proper pH, osmolarity and chemical properties for intraocular using, not cause reaction or allergy and not distort ocular hydrodynamics [11].

After the introduction of the first viscoelastic consisting of sodium hyaluronate in 1980, various OVDs have been launched. Today different concentrations and mixtures of compounds like sodium hyaluronate, chondroitin sulfate and HPMC are used to introduce visco-

elastic substances. These viscoelastics differ from one another in their physical and rheological properties. These properties show us the way to which one can be used for special applications in ocular surgery.

Viscoelastics are used in cataract surgery commonly because of they have many advantages [12]. However, they can cause elevated IOP in postoperative process if they are left in the anterior chamber [12,13]. Elevation of IOP is the most common complication within the first 24 hours after cataract surgery [14,15]. The rise usually resolves spontaneously within 72 hours in most of the cases [16]. To avoid this complication viscoelastic substance should be removed from the eye by irrigation and aspiration at the end of the surgery exactly [17]. However, although viscoelstic material is removed from the environment meticulously, they may block trabecular meshwork depending on their densities that result in IOP elevation at the early postoperative period [12,18]. Because some viscoelastics consist of large molecules that do not show outflow facility through the trabecular pores. It is believed that the clearance of viscoelastic substances depends on the viscosity and molecular weight [19]. Accordingly, viscoelastic agents which have less viscosity and low molecular weight are cleaned more rapidly from the anterior chamber [12,19].

Arshinoff., *et al*. have compared a family of molecularly similar viscoelastics (Healon5, Healon, and Healon GV) and reported that low molecular weight is less effective on IOP and increasing IOP level in postoperative process depends on patient factors than viscoelastic material [20]. Halzer., *et al*. have shown that there were no significant differences in mean elevations in IOP postoperatively at 24 hours between five viscoelastic substances (OcuCoat and Celoftal (2% HPMS), viscoat (3% sodium hyaluronate, 4% chondroitin sulfate), healon GV (1,4% sodium hyaluronate) and healon 5 (2,3% sodium hyaluronate) [21]. Luchtenberg., *et al*. have compared different viscoelastic (Adatocel, Amvisc Plus and Healon) and indicated that six hours after cataract surgery there was no significant IOP differences but at 24th hours and higher IOP was measured for Healon compared to others [22].

Mortimer C., *et al*. have shown that there were no undesirable side effects on corneal edema, iritis, endothelial cell count or intraocular pressure when 4% polyacrylamide (orcolon) was used as a viscoelastic agent in cataract surgery [6]. In another study Herrington used 4% polyacrylamide in 118 patients who had undergone anterior segment surgery and determined that use of polyacrylamide gel may cause delayed sustained increase in intraocular pressure (IOP) in 3 months follow up [7]. Laflamme and Swieca compared 4% polyacrylamide (Orcolon) and 1% sodium hyaluronate (Healon) in ease of injection, ease of removal, clarity of field and ability to hold back ocular tissues. They also evaluated intraocular pressure, corneal edema, epithelial keratitis and anterior chamber cellular reaction and indicated that orcolon causes a significantly higher IOP on the first postoperative day than healon [23]. Soares compared polyacrylamide (Medilon), healon and atmospheric air and indicated that polyacrylamide had no untoward effects on corneal edema, inflammatory processes, endothelial cell count, or IOP [24].

Polyacrylamide is a new viscoelastic material in ocular surgery. It is a synthetic solution, systematically reproducible. It is, in fact, an acrylamide homopolymer substance naturally found in fatty acids, in carotenoids and in rubber tree latex [24]. It is highly soluble in aqueous, being more easily drained from the anterior chamber. In this study, we compared the effects of this new viscoelastic, polyacrylamide with hydroxypropyl methylcellulose on postoperative IOP elevation. We found that polyacrylamide did not increase postoperative IOP significantly in any measurements.

To conclude, polyacrylamide seems to be safer than HPMS. In case, it is considered that polyacrylamide has no effect on IOP elevation even though it was retained in the anterior chamber, capsular fornix or retrolental space. However, these findings need further investigation in larger prospective trials.

Bibliography

1. Oxford Cataract Treatment and Evaluation Team (OCTET). "Long-term corneal endothelial cell loss after cataract surgery: Results of a randomized controlled trial". *Archives of Ophthalmology* 104.8 (1986): 1170-1175.

2. Bissen-Miyajima H. "Ophthalmic viscosurgical devices". *Current Opinion in Ophthalmology* 19.1 (2008): 50-54.

3. Davis AE and Lindstrom RL. "Corneal thickness and visual acuity after phacoemulsification with 3 viscoelastic materials". *Journal of Cataract and Refractive Surgery* 26.10 (2000): 1505-1509.

4. Espíndola RF., *et al*. "A clinical comparison between DisCoVisc and 2% hydroxypropylmethylcellulose in phacoemulsification: a fellow-eye study". *Clinics* 67.9 (2012): 1059-1062.

5. Modi SS., *et al*. "Safety, efficacy, and intraoperative characteristics of DisCoVisc and Healon ophthalmic viscosurgical devices for cataract surgery". *Clinical Ophthalmology* 5 (2011): 1381-1389.

6. Mortimer C., *et al*. "Efficacy of polyacrylamide vs. sodium hyaluronate in cataract surgery". *Canadian Journal of Ophthalmology* 26.3 (1991): 144-147.

7. Herrington RG., *et al*. "Delayed sustained increase in intraocular pressure secondary to the use of polyacrylamide gel (Orcolon) in the anterior chamber". *Ophthalmic Surgery* 24.10 (1993): 658-662.

8. Miyata K., *et al*. "Corneal endothelial cell protection during phacoemulsification; low versus high molecular weight sodium hyaluronate". *Journal of Cataract and Refractive Surgery* 28.9 (2002): 1557-1560.

9. Rainer G., *et al*. "Intraocular pressure after small incision cataract surgery with Healon5 and Viscoat". *Journal of Cataract and Refractive Surgery* 26.2 (2000): 271-276.

10. Arshinoff SA and Jafari M. "New classification of ophthalmic viscosurgical devices – 2005". *Journal of Cataract and Refractive Surgery* 31.11 (2005): 2167-2171.

11. Liesengang TJ. "Viscoelastics substances in ophthalmology". *Survey of Ophthalmology* 34.4 (1990): 268-293.

12. Rainer G., *et al*. "Intraocular pressure rise after small incision cataract surgery: a randomised intraindividual comparison of two dispersive viscoelastic agents". *British Journal of Ophthalmology* 85.2 (2001): 139-142.

13. Tanaka T., *et al*. "Relationship between postoperative intraocular pressure elevation and residual sodium hyaluronate following phacoemulsification and aspiration". *Journal of Cataract and Refractive Surgery* 23.2 (1997): 284-288.

14. Benson FG., *et al*. "Obstruction of aqueous outflow by sodium hyaluronate in enucleated human eyes". *American Journal of Ophthalmology* 95.5 (1983): 668-672.

15. Dietlein TS, *et al*. "Early postoperative spikes of the intraocular pressure (IOP) following phacoemulsification in late-stage glaucoma". *Klinische Monatsblätter für Augenheilkunde* 223.3 (2006): 225-229.

16. Barron BA., *et al*. "Comparison of the effect of Viscoat and Healon on postoperative intraocular pressure". *American Journal of Ophthalmology* 100.3 (1985): 377-384.

17. Jacobi PC., *et al*. "Effect of trabecular aspiration on early intraocular pressure rise after cataract surgery". *Journal of Cataract and Refractive Surgery* 23.6 (1997): 923-929.

18. Holmberg AS and Philipson BT. "Sodium hyaluronate in cataract surgery. I. Report on the use of Healon in two different types of intracapsular cataract surgery". *Ophthalmology* 91.1 (1984): 45-52.

19. Lane SS, *et al*. "Prospective comparison of the effects of Occucoat, Viscoat, and Healon on intraocular pressure and endothelial cell loss". *Journal of Cataract and Refractive Surgery* 17.1 (1991): 21-26.

20. Arshinoff S. "Postoperative intraocular pressure spikes". *Journal of Cataract and Refractive Surgery* 30.4 (2004): 733-734.

21. Holzer MP., *et al*. "Effect of Healon5 and 4 other viscoelastic substances on intraocular pressure and endothelium after cataract surgery". *Journal of Cataract and Refractive Surgery* 27.2 (2001): 213-218.

22. Luchtenberg M., *et al*. "Intraocular pressure response after administration of 3 different viscoelastic agents after cataract operation". *Ophthalmologe* 97.5 (2000): 331-335.

23. Laflamme MY and Swieca R. "A prospective comparison of 4% polyacrylamide (Orcolon) and 1% sodium hyaluronate (Healon) in cataract and intraocular lens implant surgery". *Canadian Journal of Ophthalmology* 25.5 (1990): 229-233.

24. Emyr Farancisco soares. "Endothelial protection in facectomies: assessment of a new synthetic viscoelastic material". *Arquivos Brasileiros de Oftalmologia* 62 (2010): 96-100.

Volume 8 Issue 3 November 2017
© All rights reserved by Tevfik Ogurel., *et al*.