INTRAOCULAR PRESSURE AFTER SMALL INCISION CATARACT SURGERY WITH TWO DIFFERENT VISCOELASTIC AGENTS

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SUMMARY: Viscoelastic agents are used widely in ophthalmic surgery. This study was designed to assess the effect of Healon (sodium hyaluronate 1%) and Coatel (Hydroxymethylpropylcellulose 2%) on intraocular pressure (IOP) after small incision of cataract surgery.

In a prospective randomized clinical trial, 87 eyes of 87 patients with senile cataract from Nikookari Ophthalmology Center of Tabriz, underwent small incision cataract surgery with phacoemulsification and randomly assigned to receive Healon or Coatel. IOP was measured preoperatively, 24 hours, 3 days and 1 month after surgery and postoperative values were compared with preoperative ones.

In each group mean of 3 postoperative IOPs were compared with preoperative values and a significant difference was found in two groups ($p = 0.013$ for Healon and $p = 0.004$ for Coatel). After 20-24 hours, mean IOP in Healon group increased significantly ($p = 0.047$) but in Coatel group there was no significant change ($p = 0.56$).

Three days and also one month after surgery, mean IOP in two groups reduced significantly to lower values of baseline ($p<0.001$ in either group).

According to our results, there was no significant difference between the mean postoperative IOPs using two different viscoelastic agents and they were similar in effectiveness. It seems that complete removal of viscoelastic substances from anterior chamber, behind the intraocular lens (IOL), posterior chamber and enough washout time reduced the incidence of ocular hypertension in postoperative period.

Key Words: Healon, Coatel, Intraocular Pressure (IOP), Cataract, Viscoelastic agents.

INTRODUCTION

Application of viscoelastic substances has improved quality of anterior chamber surgery. The first use of viscoelastic agents in cataract surgery was described in 1972 by Balazs *et al.* (1).

A stable anterior chamber is advantageous in cataract surgery. The major aim of the application of viscoelastic substances in cataract surgery is prevention of corneal endothelial cell loss. Maintaining of the anterior chamber, mechanical protection of the corneal endothelium against surgical trauma, absorption of ultrasound energy, coating of intraocular lens and facilitation of the surgical procedure during anterior chamber surgery and intraocular lens (IOL) implantation are the most important advantages of these agents (2-6).

Viscoelastic agents have been used widely in small incision cataract surgery, the most frequently performed technique. Viscoelastic agents according to their bio-

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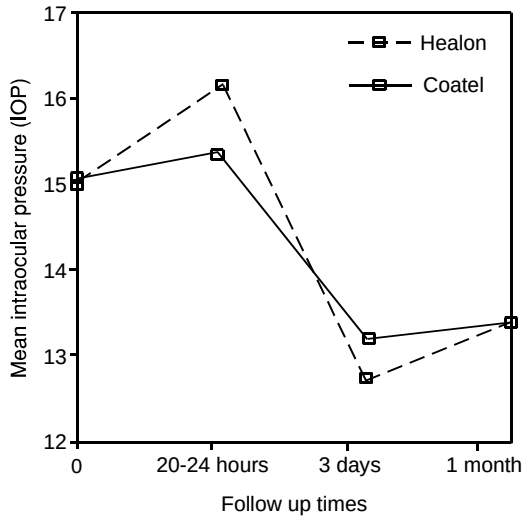
Figure 1: IOP changes during the follow up period.



chemical and physical properties are divided into two groups; dispersive and cohesive (2, 7). Cohesive agents such as Healon (sodium hyaluronate) have high viscosity and dispersive materials such as Coatel (Hydroxymethylpropylcellulose) have low viscosity and high adhesive property. The dispersive nature causes better adherence of the agent to corneal endothelium (8); by which perhaps provides better protection of endothelium during phacoemulsification. But because of coating the intraocular surfaces, removing dispersive agents after surgery is more difficult than cohesive materials (7).

The major complication of viscoelastic materials usage within first 24 hours after cataract surgery is perhaps responsible of higher postoperative intraocular pressures (IOP) (9-11). Leaving a significant amount of an agent in the anterior chamber, with obstruction of the outflow of the aqueous humor from the anterior chamber may cause IOP rise (12-15). This may be due to mechanical obstruction of trabecular meshwork (TM) or functional or instructional damage of TM (16).

Thus a potential disadvantage, however, is the difficulty of completely removing the dispersive viscoelastic agents at the end of surgery that possibly results in an increased IOP which in return produces various complications.

As there is no study to report the effects of Coatel on postoperative IOP we conducted a prospective randomized clinical trial to investigate the effect of Coatel and Healon on postoperative IOP after small incision cataract surgery.

PATIENTS AND METHODS

In a prospective randomized clinical trial, 87 eyes of 87 patients with senile cataract who were referred for cataract surgery to Nikookari Ophthalmology Center of Tabriz were recruited in the study. Mean age of the patients was 66.9 ± 8.8 years and 47% (41) of them were male and 53% (46) female. The study protocol was approved by the ethics committee of Tabriz University of Medical Sciences. After explanation of the study, written informed consent was obtained from all patients.

Patients with traumatic cataract, ocular hypertension (IOP $\geq$ 22 mmHg), history of previous ophthalmic surgery and other ophthalmologic disorders except non proliferative diabetic retinopathy (NPDR) and pseudoexfoliation syndrome (PEX) were excluded from the study. All patients underwent small incision cataract surgery, using standard phacoemulsification technique by the same surgeon (JA). After the preoperative examination, each patient randomly assigned to receive Coatel (hydroxypropylmethylcellulose 2%) (Bausch and Lomb. Co.) or Healon (sodium hyaluronate 1%) (Pharmacia. A.D.) during surgery. The surgeon was not masked about the assigned viscoelastic agent in each patient. The baseline IOP was measured by Goldman applanation tonometry on the day before surgery. The IOP was again measured with the same method 20-24 hours, 3 days (72 hours) and 1 month after surgery. Information about diabetes, PEX and demographic characteristics were completed in a questionnaire for each patient. Approximately 30 minutes-1 hour before surgery tropicamide 1%, 3 drops every 5 minutes were instilled. Phacoemulsification (by Storz protege machine) was performed under general anesthesia. A clear corneal incision was made at 12 o'clock using a 3.2 mm phaco knife. Two other limbal stab incisions at 2:30 and 9:30 o'clock were performed by a 15° knife. Assigned viscoelastic agent was injected to keep the anterior chamber formed. A capsulorhexis was performed via stab incision and hydrodissection was carried out using balanced salt solution (BSS). Phacoemulsification was performed using appropriate power with nuclear stiffness and followed by aspiration of the cortical remnants and cleaning of the capsular bag using bimanual cannula by irrigation/aspiration, (I/A) tip. The phaco and I/A settings were identical for all procedures. The capsular bag and anterior chamber was then filled with the assigned viscoelastic agent, and a foldable IOL (Akreos, Bausch and Lomb. Co) was implanted in the capsular bag. After confirming of lens implantation, washout (irrigation and aspiration) of viscoelastic agent was performed for duration of 20 seconds thoroughly from capsular bag, behind the IOL, posterior and anterior chamber using an I/A tip. After subconjunctival injection of cephazoline and betamethasone, the eye was patched.

Table 1: Mean Pre and 3 postoperative IOP in Healon and Coatel groups.

	Preoperative	Postoperative IOP			Mean 3
	IOP	20-24 hours	3 days	1 month	postoperative IOP
Healon	14.97 ± 2.32	16.13 ± 3.26*	12.68 ± 1.62*	13.38 ± 1.61*	14.06 ± 1.67
Coatel	15.04 ± 3.00	15.34 ± 2.77	13.18 ± 1.68*	13.39 ± 1.65*	13.97 ± 1.57

* $p < 0.05$, significant difference with preoperative IOP.

Group comparisons of the preoperative and postoperative IOP and of the mean IOP changes from preoperatively to 20-24 hours, 3 days, and 1 month postoperatively were down using paired T-tests and Minitab. A p value < 0.05 was considered statistically significant.

RESULTS

Mean patients' ages in two groups were not significantly different (66 ± 6.7 Healon vs. 67.8 ±10.5 Coatel, p= 0.3). Forty three patients received Coatel (26 males and 17 females) and 44 Healon (15 males and 29 females). Also there was no significant difference between two groups considering diabetes mellitus, PEX disorders.

There was no significant difference in preoperative IOP between groups (p = 0.40). No significant difference was found between means of 3 postoperative IOPs of the two groups (p = 0.79). In each group means of 3 postoperative IOPs were compared with preoperative value and significant differences were found in two groups (p = 0.013 for Healon and p = 0.004 for Coatel).

Mean IOP changes from preoperatively to 20-24 hours, 3 days, and 1 month postoperatively are shown in Table 1.

At 20-24 hours postoperatively, mean IOP in Healon group increased significantly from baseline (p = 0.047) but in Coatel group the difference was not significantly different (p = 0.56) (Table 1).

Three days after surgery, mean IOP reduced significantly from baseline (p < 0.001 in two groups). At one month postoperatively, also a significant decrease was found in IOP from baseline in two groups (p<0.001 in either group) (Table 1).

At 20-24 hours after surgery no eye was diagnosed with IOP > 26 mmHg in either group. The highest IOPs in 20-24 hours postoperatively were 26 mmHg in Healon group and 22 mmHg in Coatel group.

DISCUSSION

The first available viscoelastic substance, Healon, made cataract surgery safer and easier (17). Incomplete removal of viscoelastic agents after surgery can obstruct the TM and the canal of Schlemm (due to their viscosity) and resulting in IOP rise (5). As Jurgens *et al.* reported, highly viscous agents (such as Healon GV and Healon5) can cause significant IOP rise and small-incision techniques cause higher postoperative IOPs (in first 24 hours) (18).

We studied the effect of two viscoelastic agents (Coatel and Healon) on postoperative IOP. Our study did not assess the short term effects of two agents, but after 20-24 hours IOP increased significantly in Healon group but remained without significant change in Coatel group. After 3 days mean IOP declined significantly from baseline in both groups and after 1 month it returned to near preoperative values but it was yet significantly lower.

Various animals (in rabbits and dogs) and human studies have investigated IOP changes during ophthalmic surgery have been conducted in using different cohesive and adhesive viscoelastic agents with various concentrations (19-25). Most of these studies showed IOP rise in short term postoperative period, especially using dispersive agents (6-8 hours) return to near baseline or even lower values after 20-24 hours as well as after 1 week or more (19-25). These results were confirmed by our study.

Rainer *et al.* (25), observed IOP rise despite equal removal of both Ocucoat and Viscoat from the anterior chamber and behind the IOL. They concluded that the difference in postoperative IOP increase between the two agents may be due to differences in their biophysical properties. The clearance of the viscoelastic agent depends on the viscosity and molecular weight of the substances (26), therefore, the lower the viscosity and the

molecular weight, the faster is the clearance of the substance. However, another study could not find any significant difference between the IOPs using Adatocel, Amvisc Plus and Healon after 6 hours of phacoemulsification but after 24 hours a significantly higher IOP was observed by Healon rather than for the other viscoelastics (21).

Dada *et al.* (27) compared three agents (hydroxypropylmethylcellulose, Healon, and hyaluronic acid / IAL) in extracapsular cataract extraction (ECCE) with posterior chamber IOL implantation and concluded that hyaluronic acid and Healon cause early postoperative IOP increase, but similar study (12) showed a non-significant rise in IOP on day 1 followed by a significant decline at day 3 to values below the baseline and return to pre-operative values after 1 week in both groups that was repeated in our study. Lane's study (26) showed a significant IOP rise in all groups except the Viscoat removed group at 24 hours postoperatively which was not reported by others (23,25,28). In addition to viscosity and molecular weight of viscoelastic agents, washout time and technique are also two important factors involved in postoperative IOP rise. As Tanaka *et al.* showed IOP elevation is related to agent viscosity and its molecular weight and washout times of at least 10 seconds are desirable to prevent IOP elevation (29).

However, we did not observe severe IOP rise during follow up period in two groups which may be explained by washout technique or its duration. Although Healon caused IOP rise in 20-24 hours postoperatively, there was no IOP > 26 in both groups and no significant difference was found between means of 3 postoperative IOP's of two groups. Also none of the patients needed anti glaucomatous drugs. The results showed that Healon and Coatel are similar in IOP changes in medium term and their application (especially Coatel) may be of value in small cataract surgery.

CONCLUSION

In conclusion, ocular hypertension was not found during the study period with two viscoelastic agents. However, complete removal of viscoelastic substances with proper technique and enough washout time is essential to avoid a postoperative IOP increase. Further clinical trial studies with long period follow up is required to clarify the detail about the short and long term effects of Coatel on IOP.

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