DOI: https://doi.org/10.53350/pjmhs211582064

ORIGINAL ARTICLE

Effect of Hydroxypropylmethylcellulose versus Sodium Hyaluronate on corneal endothelial cell count in patients undergoing cataract surgery by phacoemulsification

FAISAL ANWAR[1], MOHAMMAD HASAN BOKHARI[2], MUHAMMAD TAHIR GHAFFAR[3], AHSAN IRSHAD[4], MUHAMMAD SHOAIB KHAN[5], HAFIZ MUHAMMAD EJAZ-UL-HAQ[6]

[1-3,5]MS Ophthalmology Department of Ophthalmology, Eye Unit 3 Mayo Hospital, Lahore

[4]MBBS, FCPS-1 PGR Shaikh Zayed Hospital, Lahore

[6]MRCSI Ophthalmology from Ireland

Correspondence to Dr. Faisal Anwar, Email: faisal.gemni@gmail.com; Cell: +92 03334865903

ABSTRACT

Objective: To compare the effect of Hydroxypropyl methylcellulose versus Sodium Hyaluronate on corneal endothelial cell count in patients undergoing cataract surgery by phacoemulsification.

Design: It was a randomized clinical trial.

Study Settings: This study was conducted at the Eye Unit III, Mayo Hospital / KEMU, Lahore over 12 months period from June 2014 to May 2015.

Hypothesis: There is a significant difference in protective effect on corneal endothelial cell loss with dispersive (Hydroxypropyl methylcellulose) viscoelastic agent as compared to cohesive (sodium hyaluronate) viscoelastic agent used during phacoemulsification with intraocular lens for the treatment of cataract.

Material and Methods: Total 80 patients from both the genders aged between 40-70 years with cataract undergoing phacoemulsification surgery were involved in this study. Two equal treatment groups were made by random allocation. Patients in Group-A (n=40) received Hydroxypropyl methylcellulose as viscoelastic agent while patients in Group-B (n=40) received treatment with Sodium Hyaluronate. Surgery was carried out by phacoemulsification technique and follow-up was done at first week, 1st month and 3rd month post-operatively. Data was collected in terms of endothelial cell count by noncontact specular microscope.

Results: Patients age was in the range of 40 to 70 years with a mean of 57.26 ± 8.00 years. There were 31 (38.75%) females and 49 (61.25%) male patients with a female to male ratio of 1.6:1. Both the groups had no statistically significant difference in the mean corneal cell count before surgery (2839.67±368.71 cells/mm2 vs. 2801.36 ± 332.52 cells/mm2; p-value= 06.27). Post-operative mean corneal cell count at 1 week, 1 month and 3 months was significantly higher in patients in Group-A compared to Group-B. Similarly, significant difference was noted across various subgroups of both the groups on the basis of patient's age and gender.

Conclusion: This study concluded that there is less corneal endothelial cell loss with dispersive Hydroxypropyl methylcellulose viscoelastic agent as compared to cohesive sodium hyaluronate viscoelastic agent used during phacoemulsification surgery with intraocular lens implant for the treatment of cataract.

Keywords: Cataract, phacoemulsification, viscoelastic agents, corneal, endothelial cell.

INTRODUCTION

Embryologically, corneal endothelium is derived from neural crest cells. With the start of second trimester of gestation, postnatal total endothelial cellularity reaches about 300,000 cells per cornea. Thereafter, with the growth of corneal surface area, there is rapid decline in endothelial cell density and a final adult density of about 2400 - 3200 cells/mm² is achieved.[1] With increased age, endothelial cells decrease in fully developed cornea.[2] Basic physiological function performed by corneal endothelium is allowing leakage of nutrients and solutes from the aqueous humor to superficial layers of the cornea and water is pumped in opposite direction actively i.e. from stroma to the aqueous. "Pump-leak hypothesis" describes this dual function performed by the corneal endothelium. The chance to develop senile / age cataract increases with increasing age. A dramatic increase in new and total number of senile cataract cases was observed during Framingham Eye Study from 1973-75 as 3.5 and 23.0 cases per 100,000 population, respectively, in persons having age 45-64 years it rose to 492.2 cases per 100,000 while in person with age 85 years or above, it was 40.8 cases per 100,000[3].

Received on 28-01-2021
Accepted on 19-07-2021

After trauma or other insults, wounding of corneal endothelium prompts healing of endothelial monolayer by enlarging adjacent endothelial cells instead of mitosis. Threshold range of endothelial cell loss varies from 500 - 1000 cells/mm² which is required for maintaining corneal deturgescence.

Coreanl endothelial cell loss is therefore a common sequel of cataract surgery. An important factor determining the extent of endothelial cell loss is viscoelastic agents used in cataract surgery. Glasser et al. found less cell loss caused by Viscoat® and Ocucoat® (2% hydroxypropylmethylcellulose) during phacoemulsification than Healon[4]. Lane et al. observed similar cell loss by Healon®, Viscoat®, and Ocucoat®, during extracapsular cataract surgery[5], while Kiss et al. observed no difference between Viscoat® and Ocucoat® during phacoemulsification[6]. Using an experimental model, Dua et al., concluded supremacy of 2% hydroxypropylmethylcellulose over sodium hyaluronate to protect endothelium from damage during I/A[7]. As there was

no much local data available on the corneal endothelial cell loss while using hydroxypropyl methylcellulose versus sodium hyaluronate in our settings and also the available literature was inadequate, so this study was conducted to determine the corneal endothelial cell loss by hydroxypropyl methylcellulose versus sodium hyaluronate by phacoemulsification in our setting to help the surgeons for selection of proper viscoelastic gel to minimize the corneal endothelial cell loss.

MATERIAL AND METHODS

It was a randomized controlled clinical trial conducted at the Eye Unit III, Mayo Hospital / KEMU, Lahore over 12 months period from June 2014 to May 2015. Sample size of 80 cases (40 in each group) was calculated with 90% confidence level and 8% absolute precision with expected percentage of Hydroxypropyl methylcellulose group as 1.2%[4] and sodium hyaluronate group as 9.6%[4]. Patients of both the genders suffering from cataract and undergoing phacoemulsification surgery presented at outpatient department were included in the study. They were aged in the range of 40-70 years. Two treatment groups were made by random allocation of patients. They had normal endothelial cell count (2400-3500) cells/mm^2 over specular microscope (SP-01 CSO) and normal fundus and adnexae on examination. Patients with eventful cataract surgery, having history of ocular trauma during life time or with corneal opacity on slit lamp examination or with another ocular surgery of same eye were excluded. Informed written consent was taken from all the patients.

Surgeries were performed under local anesthesia by using peribulbar anesthesia with 1% xylocain. Topical tropicamide 1% was used for pupillary dilatation. A 3.2 mm clear corneal tunnel was created superiorly, side port entry was made and viscoelastic gel was injected into the anterior chamber as already allocated to each group, and capsulorrhexis was performed. For achieving free rotation of nucleus, Hydrodissection and hydrodelination was done. Divide and conquer technique was used to perform phacoemulsification. Then cortical matter was thoroughly irrigated and aspirated. Viscoelastic agents were used to inflate capsular bag and implantation of 5.5 mm polymethyl methacylate lens was done. The patients were followed at 1 week, 1 month and then 3 months post-operatively when endothelial cell count was reassessed.

Same surgical team performed all the surgeries and specular microscopy was assessed on a similar chart for eliminating biasness and exclusion criteria was used to control confounding variables. All the data was entered and analyzed using SPSS 17.0. Numerical variables; age and corneal endothelial cell count before and after surgery (1 week, 1 month and 3 months) have been presented by mean ±SD. Categorical variable; gender has been presented as frequency and percentage. Independent sample t-test has been used for comparison of endothelial cell count at first week, 1 month and 3rd month postoperatively between the groups taking p-value ≤0.05 as significant. Data has been stratified for age and gender for addressing affect modifiers. Post-stratification independent sample t-test has been applied taking p-value ≤0.05 as significant.

RESULTS

Patients age was in the range of 40 to 70 years with a mean of 57.26 ± 8.00 years. There were 31 (38.75%) females and 49 (61.25%) male patients with a female to male ratio of 1.6:1. These findings have been summarized in Table 1 & 2. Both the groups had no statistically significant difference in the mean corneal cell count before surgery (2839.67±368.71 cells/mm^2 vs. 2801.36 ± 332.52 cells/mm^2; p-value= 06.27). Post-operative mean corneal cell count at 1 week, 1 month and 3 months was significantly higher in patients in Group-A compared to Group-B as shown in table 3. Similarly, significant difference was noted across various subgroups of both the groups on the basis of patient's age and gender as shown in Tables 4 and 5.

Table 1: Demographic characteristics

Characteristics	Participants
Age (years)	57.55±8.04
Gender	
• Male	49 (61.25%)
• Female	31 (38.7%)

Table-2: Age distribution

Age years	Group A (n=40)		Group A (n=40)		Total (n=80)	
-	No. of Participants	%age	No. of Participants	%age	No. of Participants	%age
40-50	08	20.0	09	22.5	17	21.25
51-60	15	37.5	16	40.0	31	38.75
61-70	17	42.5	15	37.5	32	40.0
Mean±SD	57.55±8.04		56.98±8.07		57.26±8.00	

Table 3: Mean corneal cell count pre & post-operatively in both groups.

Corneal cell count	Group A (n=40)		Group B (n=40)		p-value
-	Mean	SD	Mean	SD	-
Pre-operative	2839.67	368.71	2801.36	332.52	0.627
1st week	2665.49	267.98	2341.43	197.67	0.000
1st month	2603.51	069.04	2314.37	215.63	0.000
3rd month	2584.45	275.25	2203.25	201.46	0.000

* The difference was observed statistically significant with independent sample t-test,

Table 4: Mean corneal cell count at 3rd month post-operatively with respect to age groups.

Age years	Group A (n=40)		Group B (n=40)		p-value
-	Mean	SD	Mean	SD	-
40-50	2532.38	228.96	2146.88	182.67	0.000
51-60	2682.00	267.60	2182.17	196.68	0.000
61-70	2452.47	232.43	2234.88	210.78	0.009

* The difference was observed statistically significant with independent sample t-test,

Table 5: Mean corneal cell count at 3rd month post-operatively with respect to gender.

Age years	Group A (n=40)		Group B (n=40)		p-value
-	Mean	SD	Mean	SD	-
Male	2546.40	230.67	2188.38	208.77	0.000
Female	2607.28	301.043	2213.17	200.34	0.000

* The difference was observed statistically significant with independent sample t-test,

DISCUSSION

Although technical advancements in phacoemulsification techniques such as smaller incisions, improved machines, and better foldable intraocular lens (IOL) materials and designs have helped to reduce the degree of ocular injury but still surgical trauma stimulates the chain of ocular inflammatory reactions and induces release of inflammatory mediators.[8] For wound healing, this inflammatory response appears to be imperative. But, unwanted complications like increased intraocular pressure (IOP), cystoid macular oedema and excessive cicatrization may occur by uncontrolled inflammation.[9]

Endothelial damage is inevitably caused by cataract extraction and lens implantation owing to mechanical trauma from direct contact with IOL and instruments, trauma from fragments, irrigation fluid turbulence and air bubble exposur.[10,11] But, during cataract operation, corneal endothelium is protected by ophthalmic viscosurgical devices (OVDs) that coats endothelium and implant to avoid direct contact.[12] It provides cushion to endothelium from shearing forces and compression and helps in maintaining space for manipulation by separating implant and tissues from the endothelium.[13] This study was conducted for comparing the effect of Hydroxypropyl methylcellulose versus Sodium Hyaluronate on corneal endothelial cell count in cataract patients undergoing phacoemulsification surgery.

In this study, out of 80 patients, 49 (61.25%) were females and 31 (38.75%) were males with female to male ratio of 1.6:1. A similar female dominancy 1.7:1 was observed by Framingham[4] and 1.8:1 by Nishikori and Yamomoto.[14] Post-operative mean corneal cell count at 1st week, 1 month and 3 months was significantly higher in patients of group A as compared with patients of group B. Our observation is in line with a similar study where Dua et al. [7] also observed similar significantly higher mean endothelial cell count with the use of hydroxypropyl methylcellulose as compared to sodium hyaluronate (2395.9±451.2 vs. 2090.6±384.7 cells/mm^2; p-value<0.001).

In local population, the present study is first of its kind and adds to the limited existing evidence on the effect of hydroxypropyl methylcellulose versus sodium hyaluronate in endothelial cell count in cataract patients undergoing phacoemulsification. The results of the study confirm that hydroxypropyl methylcellulose had significantly less loss of endothelial cell count after phacoemulsification. It can be thus advocated that in future hydroxypropyl methylcellulose should be used as viscoelastic agent in patients undergoing phacoemulsification.

There is a strong limitation to the present study that complications/ side effects of these viscoelastic agents were not considered which is an important aspect of management and should be considered in future studies.

CONCLUSION

This study concluded that there is less corneal endothelial cell loss with dispersive hydroxypropyl methylcellulose viscoelastic agent as compared to cohesive sodium hyaluronate viscoelastic agent used during phacoemulsification with intraocular lens for the treatment of cataract.

REFERENCES

1. Huang J, Maram J, Tepelus TC, Modak C, Marion K, Sadda SR et al. Comparison of manual & automated analysis methods for corneal endothelial cell density measurements by specular microscopy. Journal of optometry. 2018;11(3):182-91. doi: 10.1016/j.optom.2017.06.001
2. Bansal N, Aggarwal A, Kaur P, Bedi J, Jeria S, Gusain P. A study of endothelial cell count pre-and post-neodymium-doped yttrium aluminum garnet laser iridotomy in subacute angle closure using specular microscope. Tai J Ophthalmol. 2019;9(2):104. doi: 10.4103/tjo.tjo_38_18
3. Mobaraki MM, Abbasi R, Omidian Vandchali S, Ghaffari M, Moztarzadeh F, Mozafari M. Corneal repair and regeneration: current concepts and future directions. Frontiers in bioengineering and biotechnol. 2019;7:135. doi.org/10.3389/fbioe.2019.00135
4. Glasser DB, Osborn DC, Nordeen JF, Min YI. Endothelial protection and viscoelastic retention during phacoemulsification and intraocular lens implantation. Arch Ophthalmol 1991;109:1438-40. doi:10.1001/archopht.1991.01080100118055
5. Lane SS, Naylor DW, Kullerstrand LJ. Prospective comparison of the effects of Occucoat, Viscoat, and Healon on intraocular pressure and endothelial cell loss. J Cataract Refract Surg 1991;17:21-6.
6. Kiss B, Findl O, Menapace R, et al. Corneal endothelial cell protection with a dispersive viscoelastic material and an irrigating solution during phacoemulsification: low-cost versus expensive combination. J Cataract Refract Surg 2003;29:733-40. doi.org/10.1016/S0886-3350(02)01745-5
7. Dua HS, Benedetto DA, Azuara-Blanco A. Protection of corneal endothelium from irrigation damage: a comparison of sodium hyaluronate and hydroxypropylmethylcellulose. Eye 2000;14:88-92. doi: 10.1038/eye.2000.19
8. Abdellah MM, Ammar HG, Anbar M, Mostafa EM, Farouk MM, Sayed K et al. Corneal endothelial cell density and morphology in healthy Egyptian eyes. J Ophthalmol. 2019;2019.
9. Duman R, Çevik MT, Çevik SG, Duman R, Perente I. Corneal endothelial cell density in healthy Caucasian population. Saudi J Ophthalm. 2016 Oct 1;30(4):236-9.
10. Feizi S. Corneal endothelial cell dysfunction: etiologies and management. Therapeutic advancs in ophthalmology. 2018 Dec;10:2515841418815802. doi: 10.1177/2515841418815802
11. Lee HY, Choy YJ, Park JS. Comparison of OVD and BSS for maintaining the anterior chamber during IOL implantation. Korean J Ophthalmol. 2011;25:15-21. doi.org/10.3341/kjo.2011.25.1.1
12. Ianchulev T, Lane S, Masis M, Lass JH, Benetz BA, Menegay HJ, Price FW, Lin S. Corneal endothelial cell density and morphology after phacoemulsification in patients with primary open-angle glaucoma and cataracts: 2-year results of a randomized multicenter trial. Cornea. 2019;38(3):325-31. doi: 10.1097/ICO.0000000000001826.
13. Lass JH, Benetz BA, Verdier DD, Szczotka-Flynn LB, Ayala AR, Liang W, Aldave AJ, Dunn SP, McCall T, Mian SI, Navarro LC. Corneal endothelial cell loss 3 years after successful Descemet stripping automated endothelial keratoplasty in the cornea preservation time study: a randomized clinical trial. JAMA Ophthalmol. 2017;135(12):1394-400. doi: 10.1001/jamaophthalmol.2017.4970.
14. Nishikiori T, Yamamoto K. Epidemiology of cataracts. Dev Ophthalmol. 1987;15:24-7.