

Evaluation of Early Corneal Endothelial Changes after Phacoemulsification, Trabeculectomy & Phacotrabeculectomy in Glaucoma Patients

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Abstract

Glaucoma and cataract are the leading causes of blindness worldwide. The incidence of both diseases is increasing with aging population. This prospective interventional study to investigate and compare the early effect of phacoemulsification, subscleral trabeculectomy, and combined phaco-trabeculectomy on the corneal endothelium in glaucomatous patients. Our study was conducted on 30 eyes of glaucoma patients, 10 eyes on whom combined phacotrabeculectomy was performed (Group I), 10 eyes on whom trabeculectomy was performed (Group II), and 10 eyes on whom phacoemulsification was performed (Group III). In preoperative and post-operative visits, each patient had specular biomicroscopic examination measuring corneal endothelial cell density (CECD), coefficient of variation (CV) and hexagonality (HEX) by the use of non-contact specular microscope (Nidek CEM-530, NIDEK Co., Ltd. Japan). CECD was postoperatively significantly reduced in all groups when compared to preoperative values, however, there was an insignificant difference in-between groups. Postoperatively HEX and CV showed insignificant difference when compared to preoperative data. In conclusion, phacotrabeculectomy is a safe and effective procedure causing no additional risk for corneal decompensation compared to phacoemulsification or trabeculectomy alone.

Key words: Phacotrabeculectomy, Endothelial cell loss, Specular biomicroscopy.

1. Introduction

Glaucoma and cataract are the leading causes of blindness worldwide. The incidence of both diseases is increasing with aging population [1].

Sub-scleral trabeculectomy is the most common surgery for glaucoma management [2]. Phacoemulsification alone may be an option to reduce intraocular pressure (IOP) in glaucoma patients [3]. Combined phacoemulsification with trabeculectomy may be the right choice in cases with medically uncontrolled IOP with significant cataract [4].

The corneal endothelium can perform the function of maintaining corneal clarity when it consists of healthy cells above a minimum cell density, which is reported to range between 400 – 700cells/ mm². Corneal endothelial loss can be hastened by several risk factors like; Laser iridotomy, various glaucoma surgeries and even glaucoma itself [5].

Current specular microscopes provide different outcomes that include central corneal pachymetry with an endothelial cell analysis, which includes the CECD and cell morphology providing the polymegathism or coefficient of variation or the pleomorphism (the number of six-sided [hexagonal] cell [6].

The endothelial cell loss can be measured as the increase of the endothelial individual cell surface, decrease of the endothelial cell density and the increase of the polymegathism and/or the pleomorphism [7].

2. Patients and methods

Our study was conducted on 30 eyes of glaucoma patients, 10 eyes had combined phacotrabeculectomy was performed (Group I), 10 eyes on whom trabeculectomy was performed (Group II), and 10 eyes on whom phacoemulsification was performed (Group III).

In this study inclusion criteria involved those patient; who have glaucomatous optic neuropathy, cataract but not denser than nuclear II and whose age range from 30 to 80 years. We excluded; patients older than 80 years and younger than 30 years, patients with optic disc anomalies,

patients with hereditary retinal diseases and patients with infectious keratitis and anterior chamber IOL.

Preoperative assessment of patient using full slit lamp examination, BCVA, IOP measurement and imaging with specular microscopy. The postoperative assessment was repeated on follow up visits at 1, 2 and 3 months postoperatively.

A fornix based conjunctival-tenon flap and a scleral flap of 4 X 4 mm were fashioned for all the patients on whom trabeculectomy and phacotrabeculectomy were done. Mitomycin-C (0.2 mg/ml)-soaked sponges were kept under the conjunctival and scleral flaps for 2 min. Following this stage, a second clear corneal incision at the supero-temporal area having a width of 2.75 mm was performed on.

Those patients who was performed upon phacotrabeculectomy and phacoemulsification alone. Afterward, a dispersive ocular viscoelastic device (OVD), was injected into the anterior chamber for coating the corneal endothelium in all surgical procedures. After capsulorhexis, hydrodissection and hydrodelineation, phacoemulsification was performed. A foldable intraocular lens was injected into the capsular bag. After the excision of 3X1 mm of trabecular tissue, peripheral iridectomy was done. The OVD was removed from the anterior chamber by irrigation and aspiration method. A balanced salt solution (BSS) was used for anterior chamber reformation in all surgeries. The scleral flap was sutured with 10/0 nylon. Conjunctiva was closed by vicryl 7/0 with combination of interrupted and mattress suture as needed. In the wake of the surgery, ofloxacin 0.3% was applied on all eyes 4 times per day for 1 month; prednisolone acetate 0.1% was applied hourly for the first week and 4 times per day in the succeeding 3 weeks on those patients who had had phacoemulsification and phacotrabeculectomy, whereas it was applied 4 times per day for 1 month only on those patients who had undergone trabeculectomy; cyclopentolate was applied twice per day for 2 weeks; and Tobramycin 0.3% , dexamethasone 0.1% ophthalmic ointment was used once before sleep.

Data analysis was performed using the software SPSS (Statistical Package for the Social Sciences) version 20.

Quantitative variables were described using their means and standard deviations. Categorical variables were described using their absolute frequencies and to compare the proportion of categorical data, chi square test was used when appropriate. Kolmogorov-Smirnov (distribution-type) and Levene (homogeneity of variances) tests were used to verify assumptions for use in parametric tests. variances) tests were used to verify assumptions for use in parametric tests. To compare means of two groups, independent sample t test (used with normally distributed data) was used to compare means of two groups, independent sample t test was used. To compare means of more than two groups, one way ANOVA test was used when appropriate. LSD post hoc test was used to analyze difference between each two groups when significant difference was present on ANOVA analysis. Nonparametric test (Kruskal Wallis test) was used to compare medians of more than two groups. to compare change at two points of time within the same group, paired sample t test (for normally distributed data) and Wilcoxon signed rank test (for non-parametric data) were used. To measure that change over more than two points of time, repeated measure ANOVA and Friedman tests were used. The level statistical significance was set at 5% ($P < 0.05$). Highly significant difference was present if $p \leq 0.001$.

3. Results

Comparing all groups regarding demographic data, we found a statistically non-significant difference between the studied groups regarding age and gender. As shown in table (1).

As regards to CECD we found statistically significant change in all groups table (2), however, there was non-statistically significant difference in between groups. In group I the mean CECD preoperatively was 2394 ± 265.61 which

significantly decreased to 2039.7 ± 377.89 , 2065.4 ± 410.69 in 2 and 3 months respectively, However, there was an insignificant change at 1 month postoperatively 2137.9 ± 444.248 . In group II mean CECD preoperatively was 2579.3 ± 331.359 which decreased significantly to 2289.6 ± 409.128 , 2275.9 ± 390.45 , 2217.3 ± 259.3 at 1, 2, 3 months respectively. In group III CECD significantly decreased from preoperatively 2424 ± 394.24 to 1935.182 ± 541.741 , 2117.727 ± 518.241 , 2117.727 ± 518.241 at 1, 2, 3 months postoperatively respectively.

Concerning the mean CV, there was non-statistically significant change in all groups over time and in between groups. In group I was determined preoperatively 28.4 ± 3.502 and 28.8 ± 5.287 postoperatively; where as in group II they were 27.6 ± 6.802 preoperatively and 25.7 ± 4.473 postoperatively; while in groups III they were 26 ± 3.406 and 24.909 ± 4.908 postoperatively.

As regards to, HEX the mean value in group I was determined to be preoperatively 71.8 ± 4.962 and 67.7 ± 7.875 postoperatively; where as in group II changed from preoperatively 72.2 ± 5.884 to 71.6 ± 5.461 and in group III it proved to be preoperatively 71.091 ± 5.558 and 69.091 ± 6.906 postoperatively. In all groups there was non-significant change of HEX over time and non-significant difference inbetween groups preoperatively and 2, 3 months postoperatively, however, there is significant difference between groups which had phacoemulsification and group II table (3).

Concerning best corrected visual acuity (BCVA), there was statistically significant increase in group I and III, however there was non-significant change in group II. On the other hand there was statistically significant reduction in intra-ocular pressure in group I and II; where as there was non significant change in group III

Table (1) Comparison between the studied groups regarding demographic data.

Demographic data	Groups			Test	
	Group I Mean \pm SD	Group II Mean \pm SD	Group III Mean \pm SD	F/ χ^2	P
Age (year)	63.6 \pm 8.75	56.3 \pm 9.98	63.91 \pm 4.99	2.884	0.073
Gender:	N=10 (%)	N=10(%)	N=10(%)		
Male	7 (70)	6 (60)	5 (50)	0.833	0.893
Female	3 (30)	4 (40)	5 (50)		

Table (2) Comparison between the studied groups regarding CECD pre and postoperatively.

CECD	Groups			Test	
	Group I Mean \pm SD	Group II Mean \pm SD	Group III Mean \pm SD	F	P
Preoperative	2394 \pm 265.61	2579.3 \pm 331.359	2424 \pm 394.24	0.879	0.426
1 month postop	2137.9 \pm 444.248	2289.6 \pm 409.128	1935.182 \pm 541.741	1.449	0.241
2 months postop	2039.7 \pm 377.89	2275.9 \pm 390.45	2117.727 \pm 518.241	0.761	0.477
3 months postop	2065.4 \pm 410.69	2217.3 \pm 259.3	2052 \pm 511.206	0.508	0.607
p	0.016*	0.02*	0.007*		

*we found statistically significant difference between preoperative and postoperative CECD in all groups

Table (3) Comparison between the studied groups regarding HEX pre and postoperatively.

CECD	Groups			Test	
	Group I	Group II	Group III	F	P
	Mean \pm SD	Mean \pm SD	Mean \pm SD		
Preoperative	71.8 \pm 4.962	72.2 \pm 5.884	71.091 \pm 5.558	0.111	0.898
1 month postop	67.1 \pm 5.915	72.7 \pm 8.4212	62.727 \pm 7.444	4.848	0.016*
2 months postop	70.7 \pm 6.325	65.5 \pm 6.964	67.182 \pm 7.427	1.466	0.248
3 months postop	67.7 \pm 7.875	71.6 \pm 5.461	69.091 \pm 6.906	0.508	0.442
p	0.072	0.056	0.072		

*we found statistically significant difference between Groups who had phacoemulsification and group II.

4. Discussion

We found in this study, a significant cell loss was detected in all groups postoperatively. However, there was insignificant difference between the groups.

In trabeculectomy group it was, 11.2%, 11.7%, and 14% respectively at 1, 2 and 3 months postoperative. This coincides with the study done by Wagdy et al. [8] that ascertained a significant decrease of CECD by 11.3% ,1 week after surgery but it decreased to be 10.1% at three months postoperatively, but there was no significant difference between one week and 6 months. MMC was used as an adjunctive in this study to improve success of filtration surgery that coincides with our current study.

In phacoemulsification group, we found endothelial cell loss at 1, 2 and 3 months postoperative was 20.1%, 12.6%, 15.3 respectively. This coincides with a study done by Cutolo and colleagues which demonstrated mean 14% endothelial cell loss at 1 year [9].

In phacotrabeculectomy group, we found endothelial cell loss at 1, 2 and 3 months was 10.6%, 14.7%, 13.7% respectively. However, in an earlier retrospective observational study , they found that mean endothelial cell loss was 24.85% [10].

Administration of mitomycin may be an additive risk for endothelial cell loss. In a study conducted by Zarei et al. [11], compared the endothelial cell loss between conventional trabeculectomy and trabeculectomy augmented with mitomycin .they found that MMC C application as adjunctive to trabeculectomy seems to cause a small but significant corneal endothelial loss .Most of damage occurs intra-operatively or early postoperatively ,however progressive endothelial cell loss is not a major concern.

In the contrary to these studies, decrease of corneal cell density in conjunction with trabeculectomy may be multifactorial. Effect of medical treatment of glaucoma and preservative toxicity, irido-corneal contact or lenticulo-corneal contact due to narrow angle as well as shallow anterior chamber either intra or postoperatively may be a major concern. Ischemic damage as a result of direct pressure on corneal endothelial cells due to long term course as well as high level of intraocular pressure may be another effective parameter [12].

In a recent study done by Radwan et al. concluded that intraoperative application of MMC in a concentration of 0.02% on scleral bed has not resulted in a statistically significant deleterious effect on corneal endothelium [13].

In a study conducted by Demir and colleagues, which compared early endothelial cell loss in phacoemulsification,

trabeculectomy and phacotrabeculectomy. It demonstrated significant endothelial cell loss in all groups. However, there was no significant difference in between groups which coincides with the results of our study [4].

In our study we found that the IOP decreased significantly in all groups when compared to preoperative values, however, there was a statistically non-significant difference in IOP between phacotrabeculectomy and trabeculectomy group postoperatively. On the other hand, there is a statistically significant difference between phacoemulsification and other groups regarding IOP postoperatively, while the phacoemulsification group showed lower reduction when compared to the other two groups.

Similarly, in a recent study, they found that there is a non-significant difference in IOP reduction between trabeculectomy and phacotrabeculectomy from postoperative 1 day to 3 months [14].

The results in the present study revealed that BCVA significantly increased in phacoemulsification and phacotrabeculectomy groups, however, there was no significant change in the trabeculectomy group.

These results were consistent with results obtained by Choy, who reported improvement in BCVA was better in phacotrabeculectomy group than trabeculectomy group and the difference was statistically significant [14].

5. Conclusion

In our study, performing combined procedure on those patients with cataract and glaucoma in the same session provided an effective decrease in intraocular pressure while causing no added harm to the corneal endothelium.

6. Conflict of Interest

The authors declare that they have no conflict of interest.

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