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Original Article

Trabeculectomy outcomes for patients with advanced glaucoma

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Abstract

Context
Safety and cost-effectiveness of trabeculectomy in advanced glaucoma is essential.

Aim
The aim was to evaluate the visual outcome and visual field (VF) changes in patients with advanced glaucoma who underwent trabeculectomy.

Settings and design
The study was done on 36 eyes clinically diagnosed with advanced primary open-angle glaucoma (POAG) who were uncontrolled on medical treatment and had cup-to-disc ratio (CDR) of more than 0.85 along with severe glaucomatous VF defects. The visual outcome changes were evaluated after 1 week, 1 month, and 3 months following trabeculectomy, whereas VF changes were evaluated at 3 months after trabeculectomy.

Participants and methods
Full preoperative and postoperative ophthalmological examination, including number of antiglaucoma medications, assessment of best-corrected visual acuity, intraocular pressure (IOP), gonioscopy, slit lamp biomicroscopy, and detailed fundus examination, was performed.

Statistical analysis
SPSS statistical software, version 21, was used for statistical analysis. Normality of the data was tested by Shapiro–Wilk test, as the study had non-normally distributed variables ($P < 0.05$). Analysis was done using Friedman test, and post-hoc test was further evaluated by Wilcoxon signed-rank test. Spearman correlation coefficient was computed to assess the relationship between the percentage change in IOP and the change in best-corrected visual acuity.

Results
Records of 36 eyes (17 right and 19 left) of 30 patients (14 males and 24 females) with advanced-POAG were reviewed. Median age of patients was 65.50 (43–74) years. Median preoperative VA was 0.48 (0.3–0.78), and after surgery, it improved significantly to 0.6 (0.35–0.78) ($P = 0.000$). Median preoperative IOP was 22.50 (20–25) mmHg on maximum tolerated medications, ranging 16–38, which declined significantly to 15 (13–17.75) mmHg, ranging 7–32, postoperatively ($P = 0.000$). Preoperative fundus examination showed vertical-CDR of 0.85–1, with median of 0.9 (0.9–0.95), which did not change after surgery ($P = 0.436$). Median of the number of preoperative antiglaucoma medications was 3, ranging 1–4, decreasing to zero medications, ranging 0–2 postoperatively ($P = 0.000$).

Conclusion
IOP control, decreasing number of medications, and VA improvement are the main outcomes of trabeculectomy in patients with advanced POAG. This is associated with a better quality of life in those patients as the CDR did not change.

Keywords: Advanced glaucoma, intraocular pressure, trabeculectomy

Introduction

Glaucoma is a blinding disease and a significant proportion of patients with glaucoma present late, especially in Middle East [1]. Patients with advanced glaucoma are defined as almost total cupping of the optic nerve with or without severe

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visual field loss[2]. They are at an imminent threat of losing their tubular vision [2,3]. The most frequently used glaucoma surgery is trabeculectomy, in which a partial-thickness scleral flap over a sclerectomy is created resulting in diminishing of intraocular pressure (IOP), hence less risk of further glaucomatous damage [4–6].

There are few studies that have predestined outcomes of trabeculectomy in patients with advanced glaucoma, including change in VA, cup-to-disc ratio (CDR), and the incidence of wipe-out syndrome [7]. This study evaluates the outcome of trabeculectomy in 36 eyes of advanced open-angle glaucoma (POAG).

Participants and methods

A prospective noncomparative interventional case series was conducted from November 2018 until September 2019. All patients received a thorough explanation of the study design and aims. Study participants gave an informed consent before initiation of any study-related procedures. The study adhered to the tenets of declaration of Helsinki and was approved by the Research Ethics Committee of the General Organization for Teaching Hospitals and Institutes.

The study enrolled 36 eyes with a clinical diagnosis of advanced POAG, uncontrolled with maximum tolerated topical treatment, having CDR greater than or equal to 0.85, and severe glaucomatous visual field defects, including any of the following criteria: MD less than − 12 dB, pattern deviation plot with greater than 50% of points depressed below the 5% level and greater than 25% of points depressed below 1%, any point within the central 5° with sensitivity lower to 0 dB, with both hemifields containing a point (s) with sensitivity lower to 15 dB within 5° of fixation. Patients fulfilling the inclusion criteria had full ophthalmological examination including full medical and ophthalmological history taking, number of antiglaucoma medications taken by the patient, assessment of best-corrected visual acuity (BCVA) by Landolt's C chart, assessment of the IOP using Goldman's applanation tonometry, gonioscopy using Goldmann's three-mirror lens, slit lamp biomicroscopy, and detailed fundus examination, including documenting the vertical CDR, with the 90 D Volk lens were performed.

Patients were excluded if they had other types of glaucoma such as primary angle closure glaucoma (PACG) or those associated with active ocular disease neovascular, uveitic, and aphakic glaucoma. This is to exclude different mechanisms of IOP elevation that may be factors influencing the outcome.

After proper counseling and information, the patients were subjected to subscleral trabeculectomy. Anesthesia consisted of a peribulbar injection of a 4-ml mixture of 2% lidocaine hydrochloride and 0.75% bupivacaine hydrochloride without epinephrine. Overall, 2-ml of the solution was injected into the inferior lateral orbit and 2 ml into the superior orbit with a 23-G needle by an anesthesiologist.

Trabeculectomy was performed in all eyes by the same technique. In detail, dissection of the conjunctiva was performed with a fornix-based approach and then a 4.0 × 3.0 mm scleral flap was outlined and created with a super blade and crescent knife at either the superotemporal or superonasal position. Mitomycin C of concentration of 0.4 mg/ml was applied for 2 min under the Tenon capsule and conjunctiva. Paracentesis for gradual decompression is then performed. A block of trabecular section was removed anterior to the scleral spur with a Kelly punch (Katena Products Inc., Denville, New Jersey, USA), and a peripheral iridectomy was performed. The scleral flap was sutured at its 2 corners with interrupted 10-0 nylon (Ethilon; Ethicon, Somerville, New Jersey, USA) sutures to ensure aqueous perculation while maintaining a normal depth of anterior chamber (AC). Finally, the conjunctiva and Tenon capsule incision was sutured with at least three interrupted 8-0 vicryl water-tight sutures.

All patients received topical antibiotic and steroid combination in the postoperative period. Postoperative assessment of the patients was done to look for the condition of the bleb and AC.

The visual outcome, IOP control, changes in the number of medications, and CDR were evaluated at 1 week, 1 month, and 3 months following subscleral trabeculectomy. Assessment of BCVA by Landolt's C chart, assessment of the IOP using Goldman's applanation tonometry, slit lamp bio- microscopy, and detailed fundus examination with the 90 D Volk lens were performed.

Patients' names were replaced by codes. Moreover, any sensitive information was not recorded so that the patients could not be identified.

Statistical analysis

Statistical analysis was performed with SPSS statistical software, version 21 (IBM, Chicago, Illinois, USA). Normality of the data was tested by Shapiro–Wilk test, as our study had non-normally distributed variables ($P < 0.05$). Data were expressed using median and percentiles for quantitative variables, and frequency and percentage for qualitative variables. Analysis was done using Friedman test, and post-hoc test was further evaluated by Wilcoxon signed-rank (WSR) test. The accepted level of significance in this work was stated at 0.05. *P* value less than 0.05 was considered significant. *P* value more than 0.05 is nonsignificant (NS). Spearman's correlation coefficient was computed to assess the relationship between the percentage change in IOP and the change in BCVA.

Results

The present study was conducted on 36 eyes (17 right and 19 left) of 36 patients (12 males and 24 females) with advanced POAG. Demographic and baseline clinical characteristics of patients are summarized in Table 1. The median age of patients was 65.50 years and ranged from 43 to 74 years.

There were statistically significant differences in log MAR (VA) between the preoperative and the follow-up postoperative evaluations (1 week, 1 month, and 3 months) according to Friedman's test ($P = 0.000$), and WSR test adjusted by

Bonferroni's corrections further showed a significant increase in the median log MAR (VA) from 0.48 (0.30–0.78) (6/18) preoperatively to 0.6 (0.35–0.78) (6/24) after 3 months of follow-up ($P = 0.014$). In detail, the median preoperative visual acuity (VA) was 0.48 (0.3–0.78) and ranged between light perception (log MAR = 2.7) to 6/6 (log MAR = 0).

After the surgery, both hypotony and shallow AC were recorded in five cases. Only two eyes had their central vision deteriorated: the first eye had suprachoroidal effusion and choroidal detachment owing to overfiltration that improved at 2 weeks after managing it conservatively, and the other eye experienced central retinal vein occlusion after 3 days postoperatively owing to elevated IOP and a blocked ostium. It required diode cyclophotocoagulation to control the IOP, and the visual acuity ended as no perception of light. However, overall BCVA improved to 0.6 (0.35–0.78), with a range of no perception of light (log MAR = 3) to 6/12 (log MAR = 0.18), and it was highly statistically significant ($P = 0.000$) (Table 2 and Fig. 1).

Table 1: Demographic and ocular data

Baseline clinical characteristics for patients with advanced glaucoma planned to undergo trabeculectomy	
Eye [*n* (%)]	
Number of eyes	36 (30)
Number of right eyes	17 (47.2)
Number of left eyes	19 (52.7)
Sex [*n* (%)]	
Male	12 (33.3)
Female	24 (66.6)
Age	
Range	43-74
Median (IQR)	65.50 (57-69)
IOP (mmHg)	
Range	16-38
Median (IQR)	22.50 (20-25)
log MAR visual acuity	
Range	0-2.7
Median (IQR)	0.48 (0.3-0.78)
C/D ratio	
Range	0.85-1
Median (IQR)	0.9(0.9-0.95)
Lens [*n* (%)]	
Phakic	23 (63.9)
Pseudo-phakic	13 (36.1)
Number of antiglaucoma medications	
Range	1-4
Median (IQR)	3 (3-3)
Postoperative clinical characteristics for patients with advanced glaucoma who underwent trabeculectomy	
IOP (mmHg)	
Range	7-32
Median (IQR)	15 (13-17.75)
log MAR visual acuity	
Range	0.18-3
Median (IQR)	0.6 (0.35-0.78)
C/D ratio	
Range	0.85-1
Median (IQR)	0.9 (0.9-0.95)
Number of postoperative antiglaucoma medications	
Range	0-2
Median (IQR)	0

C/D ratio, cup/disc ratio; IOP, intraocular pressure; IQR, interquartile range (the difference between third quartile (Q3) and first quartile (Q1).

There were statistically significant differences in IOP between the preoperative and the follow-up postoperative evaluations (1 week, 1 month, and 3 months) according to Friedman's test ($P = 0.000$). WSR test adjusted by Bonferroni's corrections further showed a significant decrease in the median IOP from 22.5 (20–25) mmHg preoperatively to 15 (13–17.75) mmHg after 3 months of follow-up ($P = 0.000$) (Table 2 and Fig. 2).

Preoperative fundus examination showed vertical CDR between 0.85 and 1, with median 0.9 (0.9–0.95), which did not change after surgery ($P = 0.436$). In detail, there were no statistically significant differences in CDR between the preoperative and the follow-up postoperative evaluations (1 week, 1 month, and ,3 months) according to Friedman's test ($P = 0.436$). No statistically significant differences were found between the CDR value, where the median equals 0.9 (0.9–0.95) before and after trabeculectomy according to WSR test adjusted by Bonferroni corrections ($P = 0.317$) (Table 2).

The median = number of preoperative antiglaucoma medications was 3, with range 1–4, and decreased to 0 medications, with range 0–2 postoperatively according to WSR test ($P = 0.000$) (Table 2). There was a weak positive correlation between the percentage change in IOP (difference between IOP baseline and IOP after 3 months from operation) and the change in BCVA (difference between log MAR at baseline and log MAR after 3 months), which was statistically nonsignificant ($r = 0.139$, $P = 0.418$) (Fig. 3).

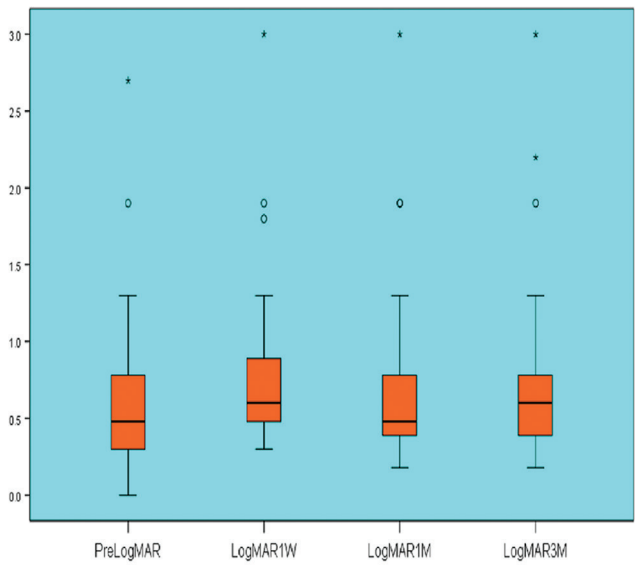

Figure 1: Boxplot showing change in visual acuity (log MAR) across the different time periods.

Table 2: Comparison of visual acuity (log MAR), IOP, CDR, and number of antiglaucoma medications across the different time periods

Variables	Preoperative	Postoperative			P_{Fr}
		1 Week	1 Month	3 Months	
Log MAR	0.48 (0.30-0.78)	0.6 (0.48-0.95)	0.48 (0.35-0.78)	0.6 (0.35-0.78)	0.000*
P_{WSR}		0.001**	0.022	0.014	
IOP	22.5 (20-25)	14 (12-15.75)	15 (13-16.75)	15 (13-17.75)	0.000*
P_{WSR}		0.000**	0.000**	0.000**	
CDR	0.9 (0.9-0.95)	0.9 (0.9-0.95)	0.9 (0.9-0.95)	0.9 (0.9-0.95)	0.436
P_{WSR}		1.000	0.480	0.317	
Medications	3 (3-3)		0		
P_{WSR}			0.000**		

Values are represented as median (IQR). IQR, interquartile range [the difference between third quartile (Q3) and first quartile (Q1)]. C/D ratio, cup-to-disc ratio; IOP, intraocular pressure. *Statistically significant at $P \leq 0.05$ according to Friedman's test. **Statistically significant at $P \leq 0.0125$ according to Wilcoxon signed-rank test adjusted by Bonferroni corrections ($P \leq 0.05/4=0.0125$).

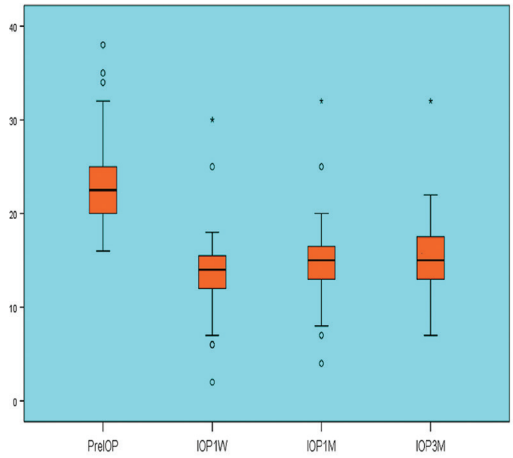

Figure 2: Boxplot showing change in intraocular pressure across the different time periods.

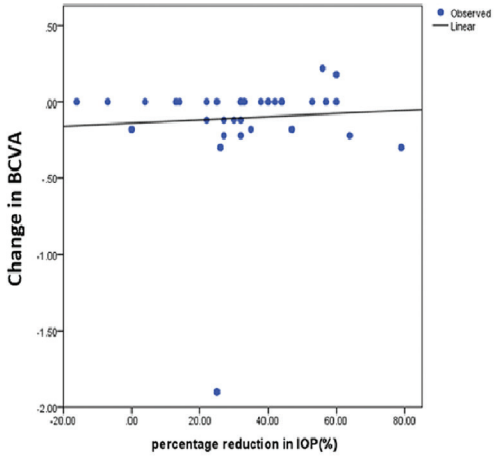

Figure 3: A scatter plot showing a positive linear correlation between the percent reduction of intraocular pressure (ΔIOP %) and the change in best-corrected visual acuity on the 3 months postoperative.

Discussion

Unexplained postoperative vision loss ('wipe-out' or 'snuff' phenomenon) has been reported after glaucoma filtering procedures in patients with advanced glaucomatous optic neuropathy [8]. Various glaucoma studies showed that severe loss of central vision after a trabeculectomy with mitomycin C could have occurred in 6% of patients who had advanced POAG [9], and despite treatment, the risk over 20 years of developing unilateral and bilateral blindness is 27 and 9%, respectively [8]. A similar Egyptian study concluded that BCVA showed no change in 63% of eyes, a visual decline was detected in 9% of eyes, whereas visual gain occurred in 28% of eyes; however, different types of glaucoma were included [10]. In our study, overall BCVA showed a significant improvement in the median log MAR (VA) from 0.48 (0.30–0.78) preoperatively to 0.6 (0.35–0.78) after 3 months of follow-up (P = 0.014). This is unique to our study; perhaps lowering the IOP by a small amount could protect the central vision and the remaining neuroretinal rim as sudden decompression is associated with complications [11].

Concerning IOP control, there is good evidence that IOP lowering can help control POAG [12,13]. In this study, we performed fornix-based trabeculectomy with mitomycin C, having a median IOP of 22.5 (20–25) mmHg, which dropped postoperatively to 15 (13–17.75) mmHg after 3 months of follow-up (P = 0.000). Only 1 eye had suprachoroidal effusion owing to overfiltration, which improved at 2 weeks after tapering the topical steroids. Another eye experienced central retinal vein occlusion after 3 days postoperatively owing to elevated IOP and the visual acuity dropped to no perception of light.

Females were in the ratio of 2 : 1 in our study, as such no consistent association of sex with POAG has been associated, but many studies showed POAG is more common in males, such as another Egyptian study [11,14]. Moreover, there were no significant differences in the CDRs preoperatively and postoperatively (P = 0.48). This can explain no patient in our study experienced wipe-out phenomenon.

Trabeculectomy still remains the gold standard surgical treatment for glaucoma. In our study, it resulted in a mean

drop of 7.5 in IOP over 3 months, in addition to a maintained and improved mean visual acuity at near preoperative levels after 3 months of follow-up. Moreover, there is a decrease in the antiglaucoma medication needed by the patient, which are costly medications thereby having good financial implications in the long term. This would be inevitably associated with better quality of life in those patients as CDR did not change. Major limitations of our study are the small number of eyes and the short-term follow-up. The study, however, still shows that surgery in advanced glaucoma can be safe and effective. In addition, studying only one type of glaucomatous patients can yield more accurate results.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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