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Visual Acuity Changes Post Trabeculectomy in Glaucoma Patients with Severe and Blindness Visual Impairment

Patcharawan Sirisawad
Ophthalmology department, Maharat Nakhon Ratchasima Hospital

Abstract

Purpose: The aim of this study was to evaluate the changes of visual acuity after trabeculectomy in glaucoma patients with severe visual impairment and blindness and to identify factors associated with visual acuity (VA) improvement six months post trabeculectomy.

Methods: This retrospective cross-sectional study enrolled 58 patients who had undergone trabeculectomy with Mitomycin C (MMC) for severe visual impairment and blindness caused by glaucoma. The primary outcome was to measure visual acuity deviations on the first day, first week, first month, third month, and sixth month post trabeculectomy and then classify them into three categories: improved VA, stable VA, and worse VA. Additionally, the factors that contributed to visual improvement were analyzed.

Results: At six months post trabeculectomy, twenty-four patients revealed VA improvement (41.4%, 95% CI: 0.283, 0.544), seven patients had worsened VA (12.1%, 95% CI: 0.050, 0.233), and twenty-seven patients had stable VA (46.5%, 95% CI: 0.333, 0.601). Preoperative visual acuity of CF1ft.-CF3ft. range (Adjusted OR =37.14; 95% CI, 2.72-507.36) revealed the best corrected postoperative VA, followed by preoperative visual acuity HM or worse (Adjusted OR =19.31; 95% CI, 2.09-178.67), then the preoperative visual acuity range of 1/60-6/60 had the least postoperative VA outcome.

Conclusions: The findings of this research conclude that patients with severe visual impairment and blindness due to glaucoma is likely to have stable and improved visual acuity six months post trabeculectomy. The preoperative visual acuity of CF1ft.-CF3ft. had the best-corrected visual acuity outcome followed by preoperative VA of HM or worse in postoperative trabeculectomy.

Keywords: Severe visual loss, Blindness, Glaucoma, Trabeculectomy, Visual improvement, Risk factor

บทคัดย่อ: การศึกษาการเปลี่ยนแปลงของการมองเห็นหลังการผ่าตัด trabeculectomy ในคนไข้ต้อหินที่มีการสูญเสียการมองเห็นก่อนผ่าตัดอยู่ในระดับรุนแรงลงไป

พัชราวรรณ ศิริสวัสดิ์*

*ภาควิชาจักษุวิทยา โรงพยาบาลมหาราชนครราชสีมา

ความสำคัญ: การรักษาโรคต้อหินในปัจจุบันนิยมเริ่มต้นด้วยการใช้ยา หากโรคไม่สามารถควบคุมได้จึงพิจารณารักษาด้วยการผ่าตัด ซึ่งผู้ป่วยต้อหินระยะท้ายและมีการสูญเสียการมองเห็นมากแล้ว (severe and blindness visual loss) เป็นกลุ่มที่เสี่ยงต่อการสูญเสียการมองเห็นทั้งจากตัวโรคเองและจากการผ่าตัด

วัตถุประสงค์: เพื่อศึกษาการเปลี่ยนแปลงระดับการมองเห็นของผู้ป่วยต้อหินหลังผ่าตัด trabeculectomy ที่มีการมองเห็นก่อนผ่าตัดอยู่ในระดับ severe and blindness visual impairment ที่ระยะเวลา 6 เดือนหลังการผ่าตัด และปัจจัยที่เกี่ยวข้องของการมีระดับการมองเห็นที่ดีขึ้น

รูปแบบการวิจัย: เป็นการศึกษารูปแบบ retrospective cross sectional design เก็บรวบรวมข้อมูลผู้ป่วยต้อหินที่มีการมองเห็นก่อนผ่าตัดในระดับ severe and blindness visual impairment ที่ได้เข้ารับการผ่าตัดด้วยวิธี trabeculectomy จำนวน 58 คน

การวัดผลและวิธีการ: ค้นข้อมูลจากเวชระเบียนของผู้ป่วย วิเคราะห์ข้อมูลด้วยสถิติเชิงพรรณนาข้อมูลพื้นฐานรายงานเป็นร้อยละ และค่าเฉลี่ย ± ส่วนเบี่ยงเบนมาตรฐานโดยใช้ chi square และ t-test เปรียบเทียบระหว่างกลุ่ม ความสัมพันธ์ระหว่างตัวทำนายทางคลินิกและกับผลลัพธ์ระดับของการมองเห็น ใช้ odd ratio จาก univariable และ multiple logistic regression

ผลการศึกษา: ที่ระยะเวลา 6 เดือนหลังผ่าตัด trabeculectomy พบว่าผู้ป่วย 24 คน มีระดับการมองเห็นดีขึ้น (41.4%, 95% CI: 0.283, 0.544), 7 คน มีการมองเห็นแย่ลง (12.1%, 95% CI: 0.050, 0.233) และ 27 คนมีการมองเห็นไม่ต่างจากเดิม (46.5%, 95% CI: 0.333, 0.601) โดยปัจจัยที่มีผลต่อระดับการมองเห็นที่ดีขึ้นหลังการผ่าตัด คือ ระดับการมองเห็นก่อนผ่าตัด พบว่าระดับการมองเห็นในช่วง CF'1-CF'3 จะมีโอกาสมีการมองเห็นหลังผ่าตัดดีขึ้นมากที่สุด (Adjusted OR =37.14; 95% CI, 2.72-507.36) รองลงมาคือ ระดับการมองเห็นที่น้อยกว่า HM (Adjusted OR =19.31; 95% CI, 2.09-178.67) เมื่อเทียบกับระดับการมองเห็น 1/60 – 6/60

ผลสรุป: การเปลี่ยนแปลงระดับการมองเห็นหลังการผ่าตัด trabeculectomy ของผู้ป่วยต้อหินที่มีระดับการมองเห็น severe and blindness visual impairment ผู้ป่วยส่วนใหญ่มีโอกาสมองเห็นไม่ต่างจากเดิมหรือดีขึ้นหลังการผ่าตัดที่เวลา 6 เดือน โดยพบว่าการที่มีระดับการมองเห็นก่อนผ่าตัดน้อยกว่าหรือเท่ากับ finger cout 3 feet ลงมา มีโอกาสมีการมองเห็นดีขึ้นมากที่สุดที่ระยะเวลา 6 เดือน

คำสำคัญ: ต้อหิน การผ่าตัดต้อหิน ตาบอด การมองเห็นดีขึ้น ปัจจัยที่มีความสัมพันธ์

Introduction

Glaucoma is defined as chronic progressive optic neuropathy that leads to visual loss and blindness. Elevated intraocular pressure (IOP) is the major risk factor in developing and progression of glaucoma[1,2]. The aim of treatment is to decrease IOP to prevent progression and preserve visual function. Many studies have reported that the surgical lowering of IOP in glaucoma can slow the progression of visual field loss[1–3]. However, some patients who underwent trabeculectomy experienced visual deterioration. Previous studies reported 8.3% of patient demonstrated a loss of visual acuity after 3 months of trabeculectomy[4] and 8% had permanent vision loss[5] .The risk factors for visual loss after trabeculectomy were old age, advanced glaucoma, hypertension, CVD, preoperative high IOP, postoperative hypotony, poor preoperative visual loss, advanced glaucomatous visual field loss and postoperative complication[4,6,7].

Advanced glaucoma patients and glaucoma patients who had severe visual impairment and blindness are hard to detect disease progression. Due to the advanced stage of the disease and poor visual acuity, structural and visual field test became extremely limited. The IOP and the changing of VA are some of the indicators in detecting progression of the disease[8]. Currently, no study has evaluated the changes in VA and visual prognosis in patients who underwent trabeculectomy with severe visual impairment and blindness due to glaucoma. Thus, the purpose of this study was to determine the changes in visual acuity post trabeculectomy in patients with glaucoma who had severe visual impairment and blindness, as well as to identify relevant factors in patients who had improved visual acuity six months after trabeculectomy.

Methods

This is a cross-sectional retrospective study, wherein the participants enrolled met the inclusion and exclusion criteria and had trabeculectomy with MMC between July 2017 and January 2021. The same glaucoma specialist performed the trabeculectomy with MMC procedure on all participants using the standard technique.

Inclusion criteria were patients with different types of glaucoma who had preoperative BCVA of less than or equal to 6/60 and uncontrolled IOP despite topical antiglaucoma medications. Since IOP could not be controlled with topical antiglaucoma medications alone, some patients were prescribed oral antiglaucoma medications such as acetazolamide and glycerine. Exclusion criteria included patients with mature cataracts, signs of acute angle closure glaucoma, poor visual acuity in childhood or other cause of permanent visual loss such as macular scar/atrophy, follow-up duration of less than six months post-surgery, and cataract surgery during the study period. Preoperative characteristics were determined, including age, sex, eye laterality, underlying disease, type of glaucoma, ocular disease, previous ocular surgery,

number of ocular surgeries, number of antiglaucoma medications, preoperative Snellen VA, IOP, lens status, and vertical cup-to-disc ratio. Postoperative data were collected on the first day, first week, first month, third month, and sixth month, including surgical complications, Snellen VA, and IOP. The data were analyzed for documentation of postoperative visual acuity changes, which were then classified into three groups at six months after trabeculectomy: improved VA, stable VA, and worse VA.

Definitions of specific terms

The improved VA group defined as an improved VA at 6 months post trabeculectomy at least 3 line of Snellen VA, if VA less than 6/60 an improvement have to better at least 3 steps of this following

6/60

5/60

4/60

3/60

2/60

1/60

Counting finger at 3 feet (CF'3)

Counting finger at 2 feet (CF'2)

Counting finger at 1 feet (CF'1)

HM

PJ

PL

NPL

For example; if preoperative VA was CF'3, the postoperative VA have to change at least to 3/60

The stable VA group is defined as no changes in VA, an improvement of less than 3 lines, or a deterioration not more than 2 lines in the Snellen VA from the preoperative VA at 6 months post trabeculectomy.

For example; if preoperative VA was CF'3, the postoperative VA change is within CF'1-2/60 ranges.

The Worse VA group is defined as a VA deterioration of 3 lines or more on Snellen VA at 6 months post trabeculectomy from the preoperative VA.

For example, if preoperative VA was CF'3, the postoperative VA change is at CF'1 or worse.

Statistical analysis

Stata version 14 was used for the statistical analysis. The incidence of postoperative visual acuity changes was determined using descriptive statistics. The changes were classified into three categories: improved VA, stable VA, and worse VA.

Qualitative data (categorical variables) comprised of sex, age range, eye laterality, underlying disease, type of glaucoma, ocular disease, previous ocular surgery, preoperative VA, preoperative IOP range, lens status, cup to disc ratio range, and surgical complication were expressed in percentage. To examine the significant correlation between the two groups, Chi square test and Fisher exact test were used to categorize data from binary classification.

Quantitative data (continuous variables) including logMAR VA, pre- and postoperative IOP, age, number of ocular surgeries, and number of antiglaucoma medications were recorded. The values are expressed as the mean ± SD, median and IQR. Statistical analysis of two independent groups was performed using the Student's t-test or the Kruskal-wallis H test (Mann-Whitney U test).

Logistic regression was used to ascertain the factors associated with postoperative improvement in VA. The variables of priori interest (eq., preoperative VA, CDR, and preoperative IOP) were forced into full model. The p-value of less than or equal to 0.05 is considered statistically significant.

Results

The study included 63 patients who had undergone trabeculectomy with MMC due to severe visual impairment and blindness caused by glaucoma. Five patients were excluded from the study because two patients underwent cataract surgery, and three patients did not adhere to the 6-month follow-up during the study period. This study analyzed 58 patients in total.

Baseline clinical characteristics and investigated parameters of all patients are summarized in **Table 1**. The subjects' mean age was 57.5±15.7 years (19 to 81 yrs. old). This study included primary and secondary glaucoma types, which were POAG and NVG with 15 patients (25.9%) each type, 6 patients (10.3%) had JOAG and 4 patients (6.9%) had uveitic glaucoma. There were 3 patients (5.2%) in each group of PACG and PXG, 12 patients (20.7%) had other forms of glaucoma. Cataracts were the most prevalent ocular disease. Twenty-five patients (43.2%) had one or more previous ocular surgeries prior to trabeculectomy. The ocular surgery procedures were cataract surgery in 19 patients (32.8%), pars plana vitrectomy in 6 patients (10.5%), silicone oil removal, and penetrating keratoplasty had 3 patients (5.2%) each. Preoperative visual acuity data indicated that 31 patients (53.5%) had HM or worse, 20 patients (34.5%) had visual acuity of 6/60–1/60 range and 7 patients (12.1%) had visual acuity of CF'1-

CF'3 range. The mean preoperative IOP was 29.8±12.3 mmHg but most patients had an IOP of more than 21 (65.5%) ranging from 10-60 mmHg. Each patient received at least 4 antiglaucoma medications and 50 patients (86.2%) had full cup-to-disc ratio (CDR). Five patients (8.7%) had surgical complications; two (3.5%) had wound leakage and three (5.2%) had hyphema. All of these patients received conservative treatment, and all complications resolved within 1-2 weeks.

Table 1. Clinical characteristics

Factors	Total	Improve, n=24 (%)	Control, n=34 (%)	p-value
Age				1.000
≤45	10 (17.2)	4 (16.7)	6 (17.7)	
>45	48 (82.8)	20 (83.3)	28 (82.4)	
Mean Age ,yr (SD)	57.5 (15.7)	57.75 (17.0172)	57.38235 (14.907)	0.930
Range	19-81	19-79	27-81	
Sex				0.566
- Male	40 (69.0)	18 (75.0)	22 (64.7)	
- Female	18 (31.0)	6 (25.0)	12 (35.3)	
Eye laterality				0.293
- Right	27 (46.6)	9 (37.5)	18 (52.9)	
- Left	31 (53.5)	15 (62.5)	16 (47.1)	
Type of glaucoma				0.526
- POAG	15 (25.9)	4 (16.7)	11 (32.4)	
- NVG	15 (25.9)	8 (33.3)	7 (20.6)	
- JOAG	6 (10.3)	3 (12.5)	3 (8.8)	
- Uveitis	4 (6.9)	2 (8.3)	2 (5.9)	
- PACG	3 (5.2)	0 (0.0)	3 (8.8)	
- PXG	3 (5.2)	2 (8.3)	1 (2.9)	
- Others	12 (20.7)	5 (20.8)	7 (20.6)	
Underlying disease				
- HT	24 (41.4)	12 (50.0)	12 (35.3)	0.291
- DM	19 (32.8)	8 (33.3)	11 (32.4)	1.000
- Autoimmune	2 (3.5)	0 (0.0)	2 (5.9)	0.506
Ocular disease				
- Cataract	28 (48.3)	12 (50.0)	16 (47.1)	1.000
- NPDR	1 (1.8)	1 (4.4)	0 (0.0)	0.404
- PDR	6 (10.3)	4 (16.7)	2 (5.9)	0.220
- RVO	6 (10.3)	3 (12.5)	3 (8.8)	0.684
- RRD s/p ppv	4 (6.9)	1 (4.2)	3 (8.8)	0.635
- Corneal disease	2 (3.5)	1 (4.2)	1 (2.9)	1.000

Table 1. Clinical characteristics (Cont.)

Factors	Total	Improve, n=24 (%)	Control, n=34 (%)	p-value
No. of intraocular surgery				0.278
none	33 (56.9)	15 (62.5)	18 (52.9)	
1	19 (32.8)	6 (25.0)	13 (38.2)	
2	4 (6.9)	3 (12.5)	1 (2.9)	
3	2 (3.5)	0 (0.0)	2 (5.9)	
Previous ocular surgery				
- Cataract	19 (32.8)	7 (29.2)	12 (35.3)	0.778
- PPV	6 (10.5)	2 (8.7)	4 (11.8)	1.000
- PKP	3 (5.2)	1 (4.2)	2 (5.9)	1.000
- Remove SO	3 (5.3)	0 (0.0)	3 (9.1)	0.256
Number of anti-glaucoma medication				0.287
- Mean (SD)	4.8 (0.6)	4.9 (0.1)	4.7 (0.1)	
- Range	4-6			
Preoperative VA				0.007
6/60 – 1/60	20 (34.5)	3 (12.5)	17 (50.0)	
CF'1 – CF'3	7 (12.1)	5 (20.8)	2 (5.9)	
≤ HM	31 (53.5)	16 (66.7)	15 (44.1)	
Mean logMAR (SD)	2.19 (0.779)	2.48 (0.519)	1.99 (0.871)	0.008
Range	PL–6/60	PJ–6/60	PL–6/60	
Preoperative IOP				0.266
≤ 21	20 (34.5)	8 (33.3)	12 (35.3)	
22 – 30	11 (19.0)	7 (29.2)	4 (11.8)	
> 30	27 (46.6)	9 (37.5)	18 (52.9)	
Mean (SD)	29.8 (12.3)	28.6 (11.0)	30.6 (13.3)	0.549
Range	10-60	14-53	10-60	
Lens status				0.696
- Phakic	40 (69.0)	17 (70.8)	23 (67.7)	
- Pseudophakic	16 (27.6)	7 (29.2)	9 (26.5)	
- Aphakic	2 (3.5)	0 (0.0)	2 (5.9)	
Vertical CDR				0.706
- ≤ 0.9	8 (13.8)	4 (16.7)	4 (11.8)	
- > 0.9	50 (86.2)	20 (83.3)	30 (88.2)	
Surgical complication				0.149
- No	53 (91.4)	20 (83.3)	33 (97.1)	
- Yes	5 (8.6)	4 (16.7)	1 (2.9)	

The postoperative visual acuity changed at 6 months follow up is summarized in table 2, twenty four patients (41.4%, 95% CI: 0.28, 0.54) had VA improvement, 7 patients (12.1%, 95% CI: 0.05, 0.23) had worse in VA and 27 patients (46.5%, 95% CI: 0.33, 0.60) had VA stable. The results of bivariate analysis in table 1 showed significant factor for postoperative VA improvement was preoperative visual acuity level (p=0.007). Figure 1**.** showed the changes in VA after trabeculectomy in each patient groups.The improvement in VA improves at the first day post surgery and keeps better until the sixth month post operation. In the worse VA group, the vision decreased at first day post trabeculectomy and continue to decrease until the sixth month after surgery. In the stable VA group, the VA tends to improve during the first month post trabeculectomy, then the VA return to baseline at the third month and remain relatively stable at 6 months after surgery.

Table 2. Changes in VA at 6 months post trabeculectomy

Visual changes	Number (%; 95% CI)
Improve VA	24 (41.4; 0.28, 0.54)
Stable VA	27 (46.5; 0.33, 0.60)
Worse VA	7 (12.1; 0.05, 0.23)

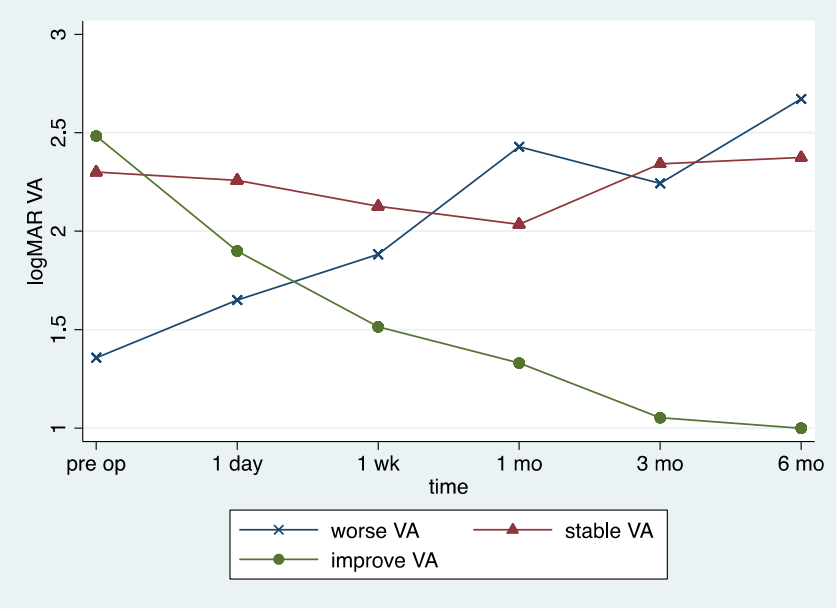

Fig. 1. Changes in visual acuity from MMC trabeculectomy. MAR: minimum angle of resolution. The blue Xs, red triangles, and green circles indicate the worse VA group, the stable VA group, and the improve VA group, respectively (n = 7, 27, and 24, respectively.)

Bivariable analysis indicated that the preoperative visual acuity level was a significant predictor of postoperative VA improvement (p=0.007). The factors related to visual acuity improvement following trabeculectomy were identified using logistic regression analysis, as shown in Table 3. Bivariable analysis revealed preoperative visual acuity (p=0.007) as the only statistically significant factor. The study included variables of interest in logistic regression analysis, which were preoperative VA, preoperative IOP, and vertical CDR size. Multivariable analysis demonstrated that the preoperative visual acuity was the factor that influenced postoperative VA improvement. The analysis revealed that preoperative visual acuity ranging from CF'1 to CF'3 was most likely to enhance postoperative VA results (AOR=37.14; 95% CI, 2.72-507.36), followed by preoperative visual acuity of HM or worse (AOR=19.31; 95% CI, 2.09-178.67), as against the preoperative visual acuity of 1/60-6/60 which had the least improvement.

Postoperative IOP values at 1 day, 1 week, 1 month, 3 months, and 6 months revealed no difference between the control and improved VA improved VA groups, as shown in Table 4. Postoperative IOP at 6 months in the control and improved VA groups was 10.5 ± 4.1 mmHg and 10.1 ± 2.9 mmHg, respectively (p=0.679). IOP reductions at 6 months postoperatively were 20.1 mmHg (13.7%) in the control group and 18.5 mmHg (10.5%) the improved VA group (p=0.282). All patients had IOP less than 21 mmHg at 6 months post operation.

Table 3. Risk factors for VA improvement at 6 months post trabeculectomy

Factors	Adjusted OR (simple) (95% CI)		Adjusted OR (95% CI)	
Preoperative VA		P-vale		P-vale
6/60–1/60	Ref		Ref	
CF'1–CF'3	14.17 (1.83,109.86)	0.011	37.14 (2.72, 507.36)	0.007
≤ HM	6.04 (1.47,24.89)	0.013	19.31 (2.09, 178.67)	0.009
CDR				
>0.9	Ref		Ref	
≤ 0.9	1.5 (0.34,6.70)	0.596	8.25 (0.63, 108.58)	0.109
Preoperative IOP				
≤ 21	1.33 (0.40,4.43)	0.639	2.04 (0.50, 8.23)	0.317
22-30	3.50 (0.81,15.16)	0.094	4.86 (0.84, 28.02)	0.077
> 30	Ref		Ref	

Table 4. Postoperative IOP of patients in the control and improved VA groups

Variable	Improved n=24 (%)	Control n=34 (%)	p-value
IOP at 1 day postoperative, mmHg (SD)	13.1 (6.67)*	14.6 (5.65)#	NA
IOP at 1 week postoperative, mmHg (SD)	14.3 (6.59)	14.9 (7.97)	NA
IOP at 1 month postoperative, mmHg (SD)	10.3 (4.20)	11.7 (4.09)	NA
IOP at 3 months postoperative, mmHg (IQR)	14.4 (9.5,17.5)	14.0 (9,20)	NA
IOP at 6 months postoperative, mmHg (SD)	10.1 (2.95)	10.5 (4.05)	0.679
IOP reduction at 1 day postoperative, mmHg (SD)	-16.0 (12.40)	-17.5 (11.80)	NA
IOP reduction at 6 months postoperative, mmHg (SD)	-18.5 (10.5)	-20.1 (13.7)	0.635

n=29, *n=21, IOP=intraocular pressure, IQR=interquartile range.

Discussion

Glaucoma is a progressive optic neuropathy that can lead to permanent vision loss. Current treatment options include medication or laser therapy, and if the disease progresses, surgical intervention is considered. Trabeculectomy is a standard surgical procedure for glaucoma that aims to maintain current vision for as long as possible in order to avoid blindness. This procedure has been shown to reduce visual field progression from 0.36 dB/year to 0.16 dB/year[3]. Previous studies have reported that trabeculectomy has a low rate of vision improvement. However, this current literature found that trabeculectomy can improve visual field in patients with mild to moderate glaucoma[9,10]. According to the Collaborative Initial Glaucoma Treatment Study (CIGTS), patients who had advanced VF loss at baseline and underwent surgical procedures demonstrated a higher probability of improving their visual fields[11]. The Otago Glaucoma Surgery Outcome Study evaluated the long-term outcomes of 841 trabeculectomies performed on patients diagnosed with primary open-angle glaucoma and primary angle-closure glaucoma, and with preoperative visual acuity greater than 6/60. The results indicated that 151 patients (18%) had improved vision following trabeculectomy, with 35 patients (23%) who underwent simultaneous cataract surgery[12]. On the other hand, trabeculectomy may lead to serious complications especially permanent visual loss, which can occur in 8%[5]. A number of researchers have identified several risk factors for permanent vision loss or blindness after trabeculectomy, including advanced glaucoma[13,14], advanced initial visual field loss[7,15,16], high postoperative IOP, surgical complication, and preoperative poor visual acuity; patients with preoperative VA greater than or equal to 0.4 logMAR VA resulted in a 5.9% risk of blindness. Preoperative VA worse than or equal to 1 logMAR VA (6/60 Snellen VA) had a 40% increased risk

of blindness[7]. For this reason, we included preoperative equal or worse than 6/60 Snellen VA in this study to examine visual prognosis outcomes after trabeculectomy.

This current study found glaucoma patients with severe visual impairment and blindness had a 41.4% VA improvement, a 12.1% reduction in vision, and a 46.5% stable vision, at six months following trabeculectomy. Elghonemy and colleagues examined visual outcome and VF change after trabeculectomy in 36 patients with advanced glaucoma. They reported a significant increase in the median logMAR VA from 0.48 (0.3-0.78) (Snellen VA=6/18) preoperatively to 0.6 (0.35-0.78) (Snellen VA=6/24) after 3 months of follow-up, p=0.014[17]. On the contrary, Baser et al. discovered no significant difference in preoperative and postoperative VA (0.87±80 logMAR and 0.89±79 logMAR, respectively) (P=0.699) in a study involving 34 eyes of 30 patients with advanced POAG[18]. Yildirim et al. found that the VA before and after trabeculectomy were 0.75 F 0.28 and 0.79 F 0.36 on the Snellen chart, respectively, in patients with POAG. Twelve months postoperatively, the results indicated a 33% improvement in vision, a 25% stability in vision, and a 42% decrease in vision[19]. However, these results differed from our study, this could be attributable to the fact that Yildirim et al.'s study was conducted over a longer period. The longer follow-up period may result in an increase in lens opacity, and consequently a greater number of patients with reduced vision. In addition, Yildirim et al. did not provide the criteria for classifying visual changes within each group as our study.

The risk factors for postoperative VA improvement were identified using logistic regression analysis. Preoperative visual acuity ranging between CF'1 and CF'3 offered an excellent chance of improving postoperative vision, followed by visual acuity less than or equal to HM when compared to VA of 1/60–6/60. These results contradict the findings of Kenji et al. who reported that having a poor preoperative VA increased the risk of blindness more than having a normal preoperative VA[7]. However, Kenji et al. excluded patients with visual impairment worse than 3/60 (blindness), which is not the case in this study. The investigators conducted an additional analysis to determine the factors that differentiate each of the 3 preoperative VA groups with improved VA. We examined age, type of glaucoma, lens status, preoperative IOP, postoperative IOP at 1 day, 1 week, 1 month, 3 months, and 6 months, as well as the difference in IOP between preoperative and 6 months after surgery. There were no differences in these variables among patients in all of the three of preoperative VA groups in the improved VA group. However, we believe that additional factors, such as vascular factor, the duration of disease progression, and the period of uncontrolled IOP prior to surgery, may affect the level of VA following surgery. Previous studies have demonstrated that surgical reduction of IOP can reverse retinal ganglion cell (RGC) dysfunction[9,20]. If the IOP is returned to a normal range within 8 weeks, the RGC may be completely functional. If the IOP is elevated for more

than 12 weeks, RGC dysfunction becomes permanent[21]. Therefore, the duration of IOP elevation prior to surgery may influence the postoperative VA prognosis in patients with glaucoma. We noted that some patients with reduced visual acuity less than CF'3 were more aware of their conditions. This may explain why patients with worse VA seek immediate medical attention and decide to undergo an immediate trabeculectomy procedure.

The findings in this report are subject to at least three limitations. First, the patient population was relatively small, which may difficult to determine all of the factors associated with postoperative VA improvement. Second, this was a retrospective study wherein certain data, such as the duration of disease progression, the period of elevated IOP prior to surgery, the time of vision loss, and the degree of lens opacity change following trabeculectomy, could not be collected exhaustively. I believe that these data may influence postoperative VA. Third, the results of this literature could not be generalized to include patients with low-tension glaucoma. Finally, this current literature evaluated changes in visual acuity after trabeculectomy that may be affected by the macular structure and vascular factors. Thus, examination of the macular and blood vessels, including the change in the thickness of the macular ganglion cell layer, the retinal nerve fiber layer, and optical coherence tomography angiography, may aid in explaining postoperative vision changes.

Conclusions

Glaucoma patients with severe visual impairment and blindness had a 41.4% improvement in VA, a 12.1% reduction in vision, and a 46.5% stable vision, at six months following trabeculectomy. Furthermore, preoperative visual acuity less than CF'3 was associated with a higher probability of improving VA than with visual acuity of 1/60-6/60. However, Patients with advanced glaucoma and those with severe visual impairment are at risk of vision loss following trabeculectomy, which must be performed with caution. The benefits of trabeculectomy must be weighed against the risk of surgical complications, such as intraocular infection. Additionally, more frequent follow-up care and hospital visits for glaucoma patients undergoing trabeculectomy must be given importance.

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