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ORIGINAL ARTICLE

Risk of visual loss in advanced glaucoma after trabeculectomy and combined cataract surgery

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ABSTRACT

Objective

This study determined the risk of postoperative visual loss and the factors affecting the decrease in visual acuity in patients with advanced glaucoma who underwent trabeculectomy or combined cataract surgery.

Methods

Charts of patients with advanced glaucoma who underwent trabeculectomy or combined cataract surgery were reviewed for the following parameters: visual acuity (VA), intraocular pressure (IOP), and visual-field indices of the Humphrey perimetry. Eyes that lost 2 or more Snellen lines or worsened one category two months after surgery were identified. Central vision was lost (wipeout) when best corrected VA was less than 20/200, characterized as a sudden, permanent, and unexplained visual loss within 2 months post-operatively. Analysis of variance (ANOVA) determined the differences between groups and logistic regression analyzed the factors affecting the decrease in visual acuity postoperatively.

Results

Ninety-eight eyes of 92 patients aged 18 years and older were included in the study. The incidence of postoperative visual loss 2 months after surgery was 20% (20/98), of which 3% (3/98) was considered "wipeout." Factors affecting the decrease in VA postoperatively include the presence of surgical complications ($p = 0.04$) and increase in postoperative IOP at two months ($p = 0.05$).

Conclusion

The incidence of wipeout among patients with advanced glaucoma who underwent trabeculectomy or combined cataract surgery is low and generally occurs in patients with central-splitting fixation. Surgical complications play a major role in causing postoperative decrease in VA.

Keywords: *Wipeout, Snuffout, Advanced glaucoma, Postoperative visual loss*

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PATIENTS with advanced glaucoma are at substantial risk of blindness arising from such causes as elevated intraocular pressure (IOP), progression of field loss, and loss of central fixation. Eyes with more advanced damage deteriorate 11 times faster,[1] and progression of field loss may occur in spite of seemingly good control of glaucoma.[2] The need for much lower IOP and individualized care in these eyes cannot be overemphasized.

Bringing down IOP in advanced glaucoma usually requires surgery, generally trabeculectomy, the most commonly performed. Trabeculectomy was successful in preventing blindness with a 54% probability after 10 years, 42% after 15.[3] Risks of filtration surgery in advanced glaucoma include endophthalmitis, increased rate of cataract surgery, progression of glaucomatous damage leading to reduced visual acuity or loss of central fixation, hypotony, and aqueous misdirection.[3]

Cataract contributes to both acuity and field loss. In the Advanced Glaucoma Intervention Study, it contributed more to acuity loss than to field loss.[4] For eyes with significant cataract and further need of IOP lowering, a combined trabeculectomy and phacoemulsification done either on the same or different sites showed better long-term IOP control than cataract surgery alone.[5] Removal of the cataract was also found to reduce visual-field deficits significantly.[4]

In advanced glaucoma with visual-field deficits encroaching central fixation, the risk of "wipeout" is a real concern. The existence of wipeout, defined as loss of central visual field in the absence of other explanation as a cause of postoperative loss of visual acuity, has been debated.[6] Considered rare, it has been shown in several studies to have an incidence of less than 2%,[6, 7, 8, 9] with one study reporting as high as 14%.[2] Its occurrence has made some ophthalmic surgeons reluctant to perform intraocular surgery in eyes with advanced glaucoma; however, its rarity should be a reason for not deferring surgery.

Thus, this study evaluated the risks of postoperative visual loss in patients with advanced glaucoma who underwent trabeculectomy or combined surgery. Specifically, we determined and compared the incidence of visual loss after trabeculectomy and combined surgery in patients with advanced glaucoma and the factors affecting the decrease in visual acuity postoperatively.

METHODOLOGY

We reviewed the charts of patients 18 years or older seen at the Glaucoma Clinic of the University of the Philippines–Philippine General Hospital from 2002 to 2004 who had advanced glaucoma and underwent trabeculectomy or combined cataract surgery [phacoemulsification with intraocular-lens (IOL) implantation and trabeculectomy or extracapsular cataract extraction (ECCE) with intraocular-lens implantation and trabeculectomy]. Eyes were defined as having advanced glaucoma if absolute field defects occurred within 10 degrees of fixation or the cup-disc ratio is greater than 0.8 associated with markedly excavated or atrophic disc as confirmed by optic-disc evaluation in the affected eye.

Included were eyes with best-corrected visual acuity (BCVA) of counting fingers (CF) at 1 foot or greater in the affected eye, no previous intraocular surgery, and a follow-up of at least 2 months. Eyes with macular problems, diabetic retinopathy, and severe myopic retinal degeneration were excluded.

Records were reviewed for the following parameters: age, gender, presence of systemic disease, family history of glaucoma, type of glaucoma, duration of glaucoma from first diagnosis, and presence of cataract. Visual acuity and IOP were recorded from the visit before surgery and postoperatively at 1 week, 1 month, and 2 months, including the use of glaucoma medication at 1 month postoperatively. Complications such as vitreous loss, shallow anterior chamber, overfiltration, and hypotony were also recorded.

In the trabeculectomy group, all surgeries were done under local anesthesia. A superior corneal bridle suture was placed for a wide exposure of the superior conjunctiva. Limbal-based conjunctival flap was made, followed by the creation of a half-thickness scleral flap. In all surgeries, 0.2-0.4 mg/ml of mitomycin-C on cotton swabs was applied for 2 to 4 minutes under the scleral flap, followed by copius irrigation. Paracentesis was placed temporally, and sclerectomy was done with the use of a Kelly-Descemet punch. A peripheral iridectomy was performed before scleral-flap closure with nylon 10-0 sutures. Adequate closure showed slow oozing of aqueous humor. Watertight conjunctival closure was achieved at the conclusion of the surgery. Topical steroid, antibiotic, and atropine 1% eye drops were given postoperatively for an average of three months, the doses gradually tapered. In combined cataract and trabeculectomy done under local anesthesia, a limbal-based conjunctival flap and a triangular scleral flap were created followed by mitomycin-C application prior to phacoemulsification on the temporal side and IOL insertion. Sclerectomy was subsequently performed, followed by iridectomy, closure of the scleral and conjunctival flaps. Those who underwent ECCE had a fornix-based conjunctival flap, followed by creation of the scleral flap, and application of mitomycin-C before the completion of the ECCE incision. The lens was delivered and IOL inserted before the wound was closed. Sclerectomy, iridectomy, and closure of the scleral flap and the conjunctiva were subsequently done. After surgery, topical steroid and antibiotic eye drops were administered.

Outcome measures included visual acuity (VA), IOP, and visual-field indices of the Humphrey perimetry such as mean defect (MD) and corrected pattern standard deviation (CPSD). The VA was measured at each visit using the standard Snellen chart; it was modeled as the logarithm of the reciprocal of the minimum angle of resolution (logMar). Eyes that lost 2 or more Snellen lines or worsened one category [categories were CF, Hand Movement (HM), Light Perception (LP), No Light Perception (NLP)] 2 months after the surgery were identified. Central vision is lost (wipeout) when BCVA is less than 20/200 or when the result of the visual-field examination confirmed the existence of a central scotoma.[6] It is characterized as a sudden, permanent, and unexplained visual loss within 2 months postoperatively. Return to the preoperative level at anytime after 2 months of follow-up was considered not to have lost central vision from the operation.[8] Mean IOP, measured with the Goldmann applanation tonometer, was calculated for each period. IOP maintained at less than 14 mm Hg with or without medication was considered successful control of IOP.[10] Visual-field results (MD and CPSD), obtained with a Humphrey Field Analyzer (Zeiss Corporation, San Leandro, CA, USA), were compared preoperatively and between 1 and 6 months postoperatively. Since not all eyes had pre- and postoperative visual fields, a subgroup analysis was done only on eyes with both fields.

Data collected were entered into MS Excel (Microsoft Corporation, Redmond, WA, USA) worksheet and subjected to statistical analysis using Statistical Analysis System (SAS) version 6.12 (SAS Institute, Cary, NC, USA). ANOVA was used to determine differences between groups. Logistic regression was performed to determine the factors predictive of decrease in VA postoperatively. The p value was considered significant if less than or equal to 0.05.

RESULTS

A total of 98 eyes of 92 patients were included in the study. Over half were female (56%). Only 10% had family history of glaucoma. Among those with systemic illnesses, 17 had hypertension and diabetes. Most had chronic angle-closure glaucoma (CACG) (52%), followed by open-angle glaucoma (OAG) (43%). Twenty patients had clear lens, the rest had mild to moderate cataracts (Table 1).

The mean age at the time of surgery was 54.4 ±12.1 years in the trabeculectomy group and 66.5 ±9.8 in the combined group; patients were older in the combined group ($p < 0.001$), and had worse preoperative VA ($p < 0.001$) (Table 1). Twenty-six percent (25/98) had VA worse than 20/200 with no visual-field analysis done. Among those with VA

Table 1. **Baseline characteristics of patients.**

Variable	Trabeculectomy	Combined Surgery	p
Number of eyes	69	29	
Number of patients	65	27	
Mean age (years)	54.4 ± 12.1	66.5 ± 9.8	<0.001
Sex			0.25
Male	33	10	
Female	36	19	
Presence of systemic illness			
Hypertension	10	5	
Diabetes mellitus	0	2	
Bronchial asthma	3	1	
Tuberculosis	3	1	
Thyroid disease	0	2	
Family history of glaucoma			0.31
Negative	60	28	
Positive	9	1	
Cataract			0.01
Negative	20	0	
Positive	49	29	
Duration of initial symptoms			0.002
<6 months	34	5	
>6 months	35	24	
Type of glaucoma			0.56
OAG[1]	29	13	
CACG[2]	37	14	
AACG[3]	3	2	
Average follow-up period	4.58 ± 1.76 months	4.34 ± 1.78 months	
Mean preoperative VA[4]	–0.42 ± 0.40	–0.83 ± 0.40	<0.001
Mean postoperative VA[4]			
1 week	–0.46 ± 0.46	–0.97 ± 0.88	0.01
1 month	–0.48 ± 0.54	–0.80 ± 0.77	0.04
2 months	–0.39 ± 0.44	–0.77 ± 0.77	0.01
Mean preoperative IOP[5]	23.93 ± 6.97 mm Hg	21.90 ± 13.10 mm Hg	0.44
Mean postoperative IOP[5]			
1 week	8.85 ± 3.88 mm Hg	10.35 ± 4.96 mm Hg	0.15
1 month	11.73 ± 4.74 mm Hg	11.85 ± 4.38 mm Hg	0.90
2 months	11.34 ± 3.98 mm Hg	12.83 ± 2.79 mm Hg	0.04
Preoperative MD[6]	–26.14 ± 5.72	–24.04 ± 3.66	0.31
Postoperative MD[6]	–24.23 ± 5.72	–32.34	0.24
Mean preoperative CPSD[7]	5.11 ± 4.55	11.87 ± 19.92	0.45
Mean postoperative CPSD[7]	5.92 ± 3.54	2.06	0.31

1. Open-angle glaucoma
2. Chronic angle-closure glaucoma
3. Acute angle-closure glaucoma
4. Visual acuity
5. Intraocular pressure
6. Mean defect
7. Corrected pattern standard deviation

better than 20/200 (73/98), 46% (34/73) had visual-field analysis, 5 in the combined group and 29 in the trabeculectomy group. Sixty-five percent (23/34) had fixation-splitting defect, described as an absolute defect extending to the horizontal meridian and completely crossing the vertical midline.[8] The others had central 5-10^0 tunnel remaining, and 1 had temporal island only. Visual-field indices for the two groups were not significantly different. The mean preoperative IOP was also similar.

Postoperative VA within 2 months did not differ significantly from baseline in the combined group. In the trabeculectomy group, similar findings were noted until the first month; by the second month, vision improved by 1 line based on the mean logMar, which was also significantly different from the combined group ($p = 0.01$).

IOP was lowest at week 1 for both groups, which gradually increased at 2 months. By 2 months, the mean IOP in the combined group was higher than in the trabeculectomy group ($p = 0.04$). ANOVA, however, showed no statistically significant difference in IOP at 1 week, 1 month, and 2 months postoperatively in each group.

Only 14 patients in the trabeculectomy group and 1 in the combined group had visual fields tested at 6 months postsurgery. Subgroup analysis of these eyes comparing visual-field defects pre- and postsurgery showed no statistical change.

There were 8 in the combined and 15 in the trabeculectomy group with decrease in VA within 2 months after surgery (Table 2). Most were females (61%). Fifty-two percent (52%) had CACG and 48% OAG. Baseline logMar VA for the trabeculectomy group was better ($p = 0.01$). Vision worsened 2 months postoperatively up to a logMar mean of –1.67 in the combined group ($p = 0.02$). The mean preoperative IOPs in both groups were not statistically different. Mean IOP at 1 week and 2 months postoperatively was higher in the combined group ($p = 0.004$ and 0.058 respectively). Twelve patients had preoperative visual-field analyses; 3 had central island and the rest had split fixation. Preoperative visual-field indices for both groups were similar. Only eyes in the trabeculectomy group had available visual-field analysis postoperatively.

Twenty-three eyes had decrease in VA that improved, but 14 did not return to their preoperative level. Visual recovery took place at 2 (5/13), 3 (4/13), and 6 (4/13) months postoperatively. Factors predictive of decrease in VA postsurgery are shown in Table 3. Surgical complications ($p = 0.045$) and increase in postoperative IOP at 2 months ($p = 0.05$) were predictive. Older age and better logMar baseline VA were not statistically significant. The type of glaucoma, type of surgery, and preoperative IOP were not predictive.

Irreversible loss of central vision developed in 3 patients with 0.9 to 1.0 cup–disc ratio; 1 in the trabeculectomy group and 2 in the combined group (1 phacoemulsification and 1 ECCE). Other causes of visual loss were excluded based on the postoperative ophthalmologic evaluation. All had CACG, and the surgeries were uncomplicated. Mean preoperative logMar VA of both groups were similar. At 2 months postoperatively, all three eyes worsened. No visual recovery was observed even after 2 months of follow-up in both groups (Table 4). The preoperative IOP in the trabeculectomy group was higher than in the combined group, but postoperative IOPs in both groups were less than 14 mm Hg.

DISCUSSION

Eyes with severe glaucomatous damage have meager remaining viable optic-nerve tissue that a dramatic decrease in visual acuity may result if any damage occurs in the remaining nerve tissue.[9] Trabeculectomy or a combined procedure is warranted for those with elevated IOP to achieve IOP control and preserve visual acuity. [3] However, not all surgeries are without risks, one of which is the phenomenon of "wipeout" or "snuffout," which may occur after an apparently uncomplicated glaucoma surgery.[11]

The existence of wipeout has been questioned and its incidence debated in several reports. In this study, the incidence of permanent postoperative visual loss in advanced glaucoma after trabeculectomy with and without cataract surgery was 3% (3/98), which is comparable to those reported in other studies.[6, 7, 8, 9] Most studies supported the existence of "wipeout" after trabeculectomy in advanced glaucoma, but this incidence is relatively low, generally less than 2%.[6, 8, 9, 12, 13] In the study by Kolker, which reported the highest incidence of 14% (3/22),[2] macular edema was considered an identifiable and reversible cause,[8] violating the definition of wipeout. Theories postulated to explain "wipeout" include the following: (1) sudden visual-acuity loss secondary to optic-nerve hemorrhage brought about by sudden decompression of the eye or sudden lowering of the IOP intraoperatively, (2) decreased perfusion pressure due to transient systemic intraoperative hypotension, and (3) toxic or direct injury to the optic nerve from retrobulbar injection.[8] The low incidence in our study could be attributed to advances and improvements in microsurgical techniques such as avoidance of sudden decompression of the globe intraoperatively and knowledge in the management of advanced glaucoma. The occurrence of wipeout in 3 cases despite lowered IOP preoperatively could be due to further compromise of the few remaining nerve fibers regardless of the IOP level.[9] Another possible cause is the occurrence of IOP spikes seen in 1 of the eyes within a month postsurgery.

Table 2. **Characteristics of patients with decrease in visual acuity postsurgery.**

Variable	Trabeculectomy	Combined Surgery	*p*
Number of eyes	15	8	0.01
Mean age (years)	58.5 ± 10.1	66.9 ± 4.2	
Sex			
Male	7	2	
Female	8	6	
Presence of systemic illness			
Hypertension	3	0	
Diabetes Mellitus	0	1	
Bronchial Asthma	0	0	
Tuberculosis	1	1	
Thyroid disease	0	1	
Family history of glaucoma			
Negative	15	8	
Positive	0	0	
Cataract			
Negative	2	0	
Positive	13	8	
Duration of initial symptoms			0.08
<6 months	5	1	
>6 months	10	7	
Type of glaucoma			0.67
OAG[1]	8	3	
CACG[2]	7	5	
AACG[3]	0	0	
Mean preoperative BCVA[4]	-0.28 ± 0.28	-0.71 ± 0.35	0.01
Mean postoperative BCVA[4]			
1 week	-0.77 ± 0.63	-1.77 ± 1.00	0.03
1 month	-0.88 ± 0.77	-1.43 ± 0.84	0.15
2 months	-0.69 ± 0.63	-1.67 ± 0.89	0.02
Mean preoperative IOP[5]	22.21 ± 4.93	28.68 ± 21.63	0.43
Mean postoperative IOP[5]			
1 week	7.9 ± 3.9	15.01 ± 4.9	0.004
1 month	10.2 ± 5.1	13.0 ± 4.8	0.21
2 months	12.3 ± 3.8	14.9 ± 2.4	0.06
Mean preoperative MD[6]	-27.33 ± 5.01	-28.23	0.91
Mean postoperative MD[6]	-23.85 ± 7.48		
Mean preoperative CPSD[7]	4.81 ± 3.59	4.39	0.94
Mean postoperative CPSD[7]	5.82 ± 3.70	-32.34	
Wipeout	1	2	
Other causes (IOP spike, lens opacification, macular edema)	12	2	
With complications			
Choroidal detachment		1	
Vitreous loss		2	
Retained cortical material		1	
Flat AC Button hole	1		

1. Open-angle glaucoma
2. Chronic angle-closure glaucoma
3. Acute angle-closure glaucoma
4. Best-corrected visual acuity
5. Intraocular pressure
6. Mean defect
7. Corrected pattern standard deviation

Table 3. **Factors predictive of decrease in visual acuity postoperatively.**

Variable	Adjusted Odds Ratio	Wald's Chi-square	*p*
Age	1.05	2.66	0.10
Diagnosis	1.02	0.001	0.97
Treatment	0.76	0.12	0.73
Complication	**5.16**	**4.03**	**0.04**
Preop IOP	1.01	0.72	0.72
Postop IOP 1 mo	0.93	0.27	0.27
Postop IOP 2 mo	**1.18**	**0.05**	**0.05**
PreopLog Mar VA	3.84	0.12	0.12

Table 4. **Characteristics of patients with wipe-out.**

Variable	Trabeculectomy	Combined Surgery
Number of eyes	1	2
Age (years)	57	71
Sex		
Male	1	0
Female	0	2
Presence of systemic illness		
Hypertension		
Diabetes Mellitus		1
Bronchial Asthma		
Tuberculosis		1
Thyroid disease		
Family history of glaucoma		
Negative	1	2
Positive		
Cataract		
Negative		
Positive	1	2
Duration of initial symptoms		
< 6 months		
> 6 months	1	2
Type of glaucoma		
OAG[1]		
CACG[2]	1	2
AACG[3]		
Preoperative BCVA[4]	-0.40	-0.42
Postoperative BCVA[4]		
1 week	-0.70	-0.62
1 month	-0.70	-0.62
2 months	-3.70	-1.85
Preoperative IOP[5]	23.83	13.48
Postoperative IOP[5]		
1 week	8	10
1 month	13	10
2 months	10	13.5

1. Open-angle glaucoma
2. Chronic angle-closure glaucoma
3. Acute angle-closure glaucoma
4. Best-corrected visual acuity
5. Intraocular pressure

The incidence of postoperative visual loss that recovered was more common in our study (20%). Causes identified were: refractive changes, lens opacification, keratopathy, maculopathy, and slow recovery of visual function in eyes with advanced glaucoma damage. Other studies have indicated that the return of maximal visual acuity after trabeculectomy or combined surgery may take 6 months or more.[11] Delayed clearing of an undiagnosed macular edema after cataract surgery is also possible.[6]

Factors predictive of decrease in postoperative visual acuity were determined. The presence of surgical complications had 5 times the likelihood of decrease in VA postoperatively (Table 3). In the combined group, vitreous loss was the most common complication encountered that led to increased inflammation and subsequent cystoid macular edema. There was increased chance of failure of the filtering surgery from the inflammation and the subsequent increase in IOP postsurgery. In the trabeculectomy group, increased risk of cataract formation or worsening of the cataract, also noted in other studies,[14] may result from persistent shallow anterior chamber postsurgery. Increase in postoperative IOP at 2 months, so called IOP spikes, had 1.2 odds of causing decrease in VA. Although the odds were low, this postoperative increase in IOP in advanced glaucoma with marginal nerve fibers left could be significant.

Better logMar baseline VA appeared to be predictive of postoperative VA but was not statistically significant. Most of the cases in this series had tunnel vision of less than 5 degrees with good VA. The risks of split fixation, cataract formation, and postoperative maculopathy in advanced glaucoma are all possible. It is believed by some investigators that macular fixation has already been lost in eyes with preoperative vision of 20/200 or less,[7] and that those with residual central island, defined as visual defects extending to within 5^0 of fixation, are more vulnerable to minor opacities and postoperative maculopathy than those whose fixation has split.[7] Our study favored the view held by Lichter and O'Connell that wipeout did not occur only in patients with split fixation.[7, 9] Thus, the VA measurement in this study may not have adequately reflected the true state of the patient's central acuity.

Older age is another factor predictive of decreased VA postoperatively; it was not significant in this study in contrast to other studies where it was strongly correlated with progression to blindness.[15] Eyes in the combined group had worse visual acuity than those in the trabeculectomy group pre- and postoperatively. Patients in the combined group were older and likely to have denser lens opacities and other subclinical retinal problems. Other studies reported strong association between older age and late glaucoma presentation,[16] with the risk increasing linearly with age over 40 years.

Our study had several limitations. The relatively small sample size for the combined group may make comparisons with the trabeculectomy group biased. The lack of pre- and postoperative visual-field tests in many patients in this study resulted in dependence on findings based solely on acuity loss rather than on acuity and field loss. Nevertheless, the finding of atrophic disc with cupping to disc margin seen in advanced glaucoma was noted in all cases. It most likely corresponded to a remaining central island on visual field.[17]

In conclusion, we found a 3% incidence of "wipeout" among patients with advanced glaucoma who have VA greater than 20/200 and underwent trabeculectomy or combined surgery. Postoperative decrease in visual acuity with an incidence of 20% in this series may be explained by several factors including the presence of intraoperative and postoperative complications and uncontrolled IOP postoperatively. Future studies with larger sample size and longer follow-up can determine the reversibility of the decrease in visual acuity in advanced glaucoma.

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