

The Probability of Blindness in Patients Treated for Glaucoma

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Background: To investigate the risk factors and probability of blindness in patients treated for glaucoma.

Methods: The study design was a retrospective, hospital-based, clinical chart, review study. Medical records were reviewed from patients seen between January 2003 and December 2003 at the Kaohsiung Chang Gung Memorial Hospital eye clinic, who had been diagnosed with glaucoma in 1986 or later and who had been treated for at least 2 years for glaucoma.

Results: A total of 186 charts were reviewed, which included 66 patients who were blind in at least one eye from glaucoma on presentation. A total of 172 patients and 290 eyes were followed-up for a mean duration of 10.6 ± 4.67 years. Twenty seven patients and 31 eyes developed blindness from glaucoma during follow-up. The Kaplan-Meier survival estimate at 16 years was 28.6% for glaucoma-related blindness in at least one eye. A worse visual field on presentation, older age, and poor compliance during therapy were significantly associated with the development of blindness. Glaucoma type, a gender difference, systemic disease, greater intraocular pressure fluctuation in the last year of therapy and blindness in one eye on presentation did not show a significant relationship with the rate of development of blindness.

Conclusion: Blindness from treated glaucoma is considerable. Our results gave a 28.6% probability of blindness at 16 years in at least one eye. An older age, poor compliance and a worse visual field on presentation were significant risk factors.

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Key words: glaucoma, blindness, intraocular pressure.

Glaucoma has long been recognized as a leading cause of blindness, but only recently has it been appreciated how numerically important it is worldwide. It has been estimated that 73 million people are affected by glaucoma worldwide and 6.7 million are thought to be blind due to this disease.⁽¹⁾ In China, it has been estimated that 9.4 million people

aged 40 years and older are affected by glaucoma and this has led to blindness in at least one eye in 5.2 million people.⁽²⁾ Although there has been progress in both medical and surgical strategies for glaucoma treatment, blindness from glaucoma still occurs despite therapy.⁽³⁻⁶⁾ Only a few studies have followed patients treated for open angle glaucoma to assess

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the rate of blindness and associated risk factors.⁽³⁻⁷⁾ Therefore, the purpose of this study was to identify the risk factors and the probability of blindness in patients with treated glaucoma.

METHODS

This study design was a retrospective, hospital-based, clinical chart, review study. All patients undergoing treatment at Kaohsiung Chang Gung Memorial Hospital (KCGMH) between January 2003 and December 2003 for glaucoma, including those with primary open-angle, normal tension, and chronic angle closure glaucoma, were eligible for inclusion in this study. The patients who were included had to have had a minimum of two years of follow-up at the time of this study and to have been diagnosed with glaucoma from 1986 onwards. Patients included in this study also needed to have documented clinical evidence of glaucomatous damage (either optic nerve damage or visual field loss consistent with glaucoma), with or without an elevated intraocular pressure (IOP) of 21 mmHg or greater.

The information recorded for each patient included date of diagnosis, age, gender, type of glaucoma, any systemic disease, initial visual acuity (VA), IOP, visual field (VF) test results, the IOP during the last year of treatment or before becoming blind, the number and types of glaucoma surgeries, medications, and noncompliance status. Noncompliance was noted and was defined as having a lapse of more than 1 year between visits, or missing multiple office visits within a single year.

Patients with ocular diseases that might confound the interpretation of visual field testing, including trauma, diabetic retinopathy, other retinal disease or surgery, neuro-ophthalmic disorders, corneal opacity, corneal transplant, or active chronic uveitis, were excluded from this study. If an event occurred during follow-up that precluded further information on the blindness from glaucoma, the patient was dropped from analysis at that time.

Legal blindness was defined as follows: corrected visual acuity of 20/200 or worse as measured by Snellen acuity. On the Goldmann visual field measurement, blindness was diagnosed at a constriction of the III4e isopter to 20° of fixation or closer in all four quadrants in a continuous line. Test objects were equivalent to the Goldmann III4e and included the

10-mm target on the tangent screen at 1 m, the size-III target at 10 dB on the Humphrey, and the size-III target at the 7 dB on the Octopus.⁽¹⁰⁾

If blindness occurred, the date of diagnosis, affected eye, and the etiology of the blindness were also abstracted. If the patients had other ocular problems that may have led to a visual hazard, they were excluded from the study.

Data (SPSS 6.1, SPSS Inc., Chicago, IL) were entered into a computer spreadsheet program. The risk of development of blindness was estimated using Kaplan-Meier survival analysis. Variables considered to be potential risk factors for blindness were evaluated using Student's *t* test, Fisher's exact test, the Chi-square test and multiple logistic regression. Results are given as the mean \pm standard deviation where applicable.

RESULTS

One hundred and eighty - six patients fulfilled the inclusion criteria. On presentation, 69 patients (83 eyes) were blind in at least one eye. Of these, blindness was due to glaucoma in 66 patients (primary open angle glaucoma (POAG) = 32 eyes, chronic angle closure glaucoma (CACG) = 46 eyes, average age 58.0 \pm 14.19 years old, 57% male). Fourteen patients started the study with blindness in both eyes and were thus excluded from this study of the development of blindness. Forty five patients had been treated by other ophthalmologists for an average of 2.7 \pm 2.9 years. In total, 172 patients and 289 eyes were enrolled in the analysis. The dataset of these 172 patients is presented in Table 1.

On follow-up, blindness developed in 29 patients and 35 eyes. The development of blindness in at least one eye from glaucoma was noted in 27 persons. These consisted of 23 patients who became blind unilaterally (8 of them were blind in one eye on

Table 1. Patient Data

Total patients participating	172
Gender	Men 91 *(52%) / women 81*(48%)
Age	56.13 \pm 12.98 years old
Follow-up duration	9.58 \pm 4.05 years
Glaucoma type	POAG 80 (46.5%) CACG 92 (53.5%)

Abbreviations: POAG: primary open angle glaucoma; CACG: chronic angle closure glaucoma.

presentation) and 4 patients who became blind bilaterally. The Kaplan-Meier estimate at 16 years for glaucoma related blindness in at least one eye was 28.6% (Figure).

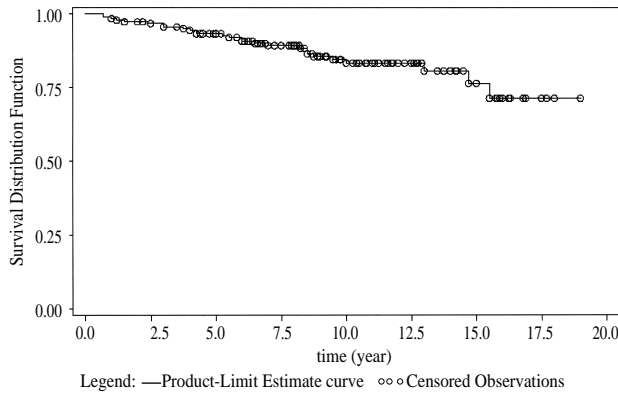


Figure. The Kaplan-Meier survival curve for glaucoma related blindness in at least one eye.

On presentation, as listed in Table 2, blindness based solely on VA criteria was noted in 22 eyes and blindness based solely on VF criteria was noted in 53 eyes. On follow-up, 4 eyes developed blindness

Table 2. Blindness by Visual Field or Visual Acuity

	Blindness by visual acuity and visual field	Blindness by visual acuity alone	Blindness by visual field alone
On presentation	3	22	53
After follow-up	0	4	27

Table 3. Analysis of Various Risk Factors for Blindness

	Blindness	No blindness	<i>p</i> * value	
			Univariate	Multivariate
VF MD	20.4 ± 6.6 dB	10.7 ± 7.2 dB	< 0.0001	< 0.0001
Age at Diagnosis	62.0 ± 9.84	54.8 ± 13.25	0.007	0.002
Gender	M = 19, F = 9	M = 71, F = 69	0.097	0.155
IOP On presentation	23.3 ± 10.1	19.16 ± 7.8	0.035	0.031
Mean IOP during the last year of follow-up	13.97 ± 4.36 range (6.5~26.5)	12.32 ± 2.79 range (4.3~20.5)	0.040	0.059
IOP variation during the last year of follow-up	10.28 ± 10.47 Range (0~40)	4.91 ± 3.10 Range (0~25)	0.008	0.148

Abbreviations: VF: visual field; MD: mean defect; IOP: intraocular pressure (in mm Hg).

* Univariate - by t-test or chi-square test; multivariate - by multiple logistic regression.

based on VA criteria compared to 27 eyes by VF alone.

Selected risk factors for the development of blindness are summarized in Table 3. For the entire dataset, patients in the blind group had a larger mean defect in the visual field (20.4 ± 6.6 vs. 10.7 ± 7.2 dB, *p* = 0.007) and were older (62.0 ± 9.84 vs. 54.8 ± 13.25, *p* < 0.001) on presentation than those in the non-blind group. The blind eye had a slightly higher but not statistically significant IOP on treatment than the non-blind eye (13.97 ± 4.36 mmHg vs. 12.32 ± 2.79 mmHg, *p* = 0.059). The variability of each patient's IOP over the last year was not significantly higher in the blind eye using multiple logistic regression analysis, with a mean range of 10.28 ± 10.47 mmHg vs. 4.91 ± 3.10 in the non-blind group (*p* = 0.148).

There were no differences in the probability of progression to blindness based on gender, glaucoma type (Chi-square test, *p* = 0.814), systemic disease (such as diabetes mellitus, hypertension or cerebral vascular disease, Fisher's exact test, *p* = 1.0) or one eye blindness on presentation. (Chi-square test, *p* = 0.523)

DISCUSSION

This study indicates the probability of blindness in treated glaucoma was 28.6% at 16 years. Previous reports have estimated the rate of glaucoma-related blindness as 27% at 20 years, 14.6% at 15 years and 19% at 22 years.⁽³⁻⁵⁾

On presentation, twice as many patients had blindness based on visual field criteria as had blind-

ness based on visual acuity criteria. On follow-up, the ratio increased to 7:1. Blindness occurred more often by visual field criteria than by visual acuity criteria. It is not uncommon for patients to have double arcuate defects but still have 20/20 visual acuity.⁽³⁾

This study showed that the mean IOP on presentation and during therapy in the patients progressing to blindness was slightly higher than in those who did not, but this was not statistically significant. This agrees with two recent reports that also did not find a difference.^(4,6) However, the group that progressed to blindness did not have a much greater IOP variability, which is contrary to the findings reported by Oliver et al.⁽⁶⁾ This could be taken to suggest that a lowering of the IOP does not necessarily prevent progression to blindness. However, the Early Manifest Glaucoma Trial study found that the risk decreased about 10% with each mmHg of IOP reduction from the base line.⁽⁷⁾ In addition, the Advanced Glaucoma Intervention Study found that there was no significant progression in field loss over a mean 6-year period if a mean IOP of 12 mmHg or lower was obtained. In most studies that have not found a protective effect when the IOP was decreased, the patients had IOPs on therapy of higher than 12 mmHg.⁽¹⁶⁾ The mean IOP for both groups of patients in Table 3 is just higher than 12 mmHg and therefore falls into this higher IOP category. This may explain the results in this study.

Noncompliance has been reported as a risk factor for blindness.⁽⁴⁾ In our patients who developed blindness, 11 out of 27 (40%) patients had poor follow-up and therefore, noncompliance was a significant risk factor in this study too.

Our study indicated that older age is a risk factor for blindness. Many reports have also correlated age as a risk factor,^(3,5,6,15) but some have not.⁽⁴⁾ A larger visual field defect on presentation was also found to be a risk in our study and this is consistent with other reports.⁽³⁻⁷⁾ Diabetes, hypertension and cardiovascular disease on presentation were not associated with a higher rate of blindness, but this may be due to selection bias, because only patients with earlier and/or minor systemic disease on presentation were included.

The rate of glaucomatous progression in recent studies has not seemed particularly rapid in most patients with treated OAG.^(5,11-13) The rate of visual field decline has been reported to be between 1.3%

and 1.5% per year.^(5,14) Oliver et al. reported that it takes about 3 years to change one stage in the group becoming blind. In addition, only when fields were compared over several years could the significance of the changes be understood.⁽⁶⁾ Although many studies have indicated that a larger visual field defect on presentation is a risk factor for the development of blindness, Kwon and associates found that the eye with the worse visual field on presentation did not necessarily progress faster; it is simply started at a stage closer to the end point.⁽⁵⁾

Our study showed that 22 out of 27 patients who developed blindness had received either surgical or laser therapy. Our results agree with the report of Oliver et al. that surgery does not prevent progression to blindness.⁽⁶⁾

In this study, blindness from glaucoma on diagnosis was 35% in at least one eye, and 14 patients were blind in both eyes. This rate is higher than in previous reports.⁽³⁻⁶⁾ One possible explanation is selection bias with respect to the patients; namely, that patients with more advanced disease and previously unsatisfactorily controlled cases may have been referred to the KCGMH medical center in preference to other hospitals.

Blindness from treated glaucoma is considerable. Our results showed a probability of blindness of 28.6% at 16 years in at least one eye. An older age, worse visual field on presentation and noncompliance are risks. Public education, greater awareness of glaucoma risk factors and the development of efficient, accurate methods of glaucoma screening are needed.

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治療過後的青光眼仍會失明的機率

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背景： 找出經過治療過後的青光眼仍會失明的可能性及可能導致失明的原因。

方法： 回顧分析於2003一整年內於高雄長庚眼科接受青光眼治療2年以上的病歷。

結果： 186名患者的病歷被分析，其中66名患者於初次到本院眼科時即因青光眼而導致失明。172名患者經過平均 10.6 ± 4.67 年的追蹤，期間有27人/31隻眼睛因青光眼導致失明。Kaplan-Meier 計算出於16年的治療後，有28.6%的機會導致一眼以上失明。初診時視野缺損較大的、年紀較長的、順從性不佳的比較容易導致失明。而性別、青光眼的類別、和初診時單眼是否失明、是否有糖尿病高血壓則和導致失明較無關係。

結論： 青光眼即使經過治療仍有相當可能性會進展到失明的階段，而年紀較長、初診時視野較差者、順從性較差者則較容易進展到失明。

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關鍵字： 青光眼，失明，眼壓。

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