SCIENTIFIC REPORT

Ten-year outcomes in newly diagnosed glaucoma patients: mortality and visual function

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Objectives: To determine the mortality within ten years of diagnosis of chronic open angle glaucoma and the visual field progression amongst survivors of a group of patients who were followed for 10 years.

Patients and methods: Of the 436 patients seen in a glaucoma case-finding clinic between July 1994 and December 1995 a diagnosis of chronic open angle glaucoma was made in 65. Ten years after diagnosis the outcome of the 57 patients who were treated at the Oxford Eye Hospital was determined. The causes of death were obtained from the general practitioner records and from the official death certificates. The probability of death was analysed using a Kaplan-Meier survival curve. The visual field of each eye of survivors was graded using a nine-stage severity scale. The visual outcome was analysed at the 10-year follow up visit.

Findings: Seventeen patients (29.8%) died during the 10-year period, including nine from cardiovascular disease. The mean (SD) age at presentation of those that died was 76.4 years (9.7) compared with 69.5 years (10.9) for survivors (p = 0.029). Using a nine-stage grading system, 42 eyes (52.5%) did not deteriorate, 30 eyes (37.5%) deteriorated by one stage, seven eyes (8.75%) two stages and one eye (1.25%) three stages over the 10-year period. The average time to first deterioration by one stage was 8.51 years (CI 7.92 to 9.10). The mean (SD) intraocular pressure was 25.6 mmHg (5.8 mmHg) on presentation and 15.7 mmHg (3.0 mmHg) at the end of 10 years.

Conclusion: Approximately two thirds of patients will still be under care 10 years after presentation. In older, white patients with glaucoma the overall goal of preventing visual handicap is achievable for most patients 10 years after diagnosis.

Glaucoma is a chronic optic neuropathy that may result in progressive visual loss over time. There is good evidence to show that the disease can be retarded by reducing the intraocular pressure (IOP).[1–3] In recent years, effective medication and reliable results from glaucoma filtration surgery have made the overall goal of preventing visual handicap achievable for most older patients if the disease is diagnosed early and the compliance is good.[4]

Life expectancy is an important factor to consider when determining the ''target'' pressure and therapeutic regimen for an individual patient. A relatively short life expectancy and the slow rate of visual field loss in treated patients helps to explain why most patients with chronic open angle glaucoma do not go blind in their lifetime.[5–7]

To study the long-term outcomes in patients with glaucoma under our care, we determined firstly, the mortality within 10 years of diagnosis and secondly, the visual field progression in survivors of a group of glaucoma patients who were treated for 10 years.

Patients and methods

The computerised database of all new patients who presented to one glaucoma specialist in a glaucoma case-finding clinic at the Oxford Eye Hospital between July 1994 and December 1995 was examined. Of the 436 patients seen during this period, a diagnosis of chronic open-angle glaucoma was made in 65 (12.6%), including 11 with normal tension glaucoma. Eight patients moved out of the region during the 10-year period and were excluded from analysis. Of the remaining 57 patients, there were 27 males and 30 females with a mean (SD) age at presentation of 71.11 (10.22) years.

The causes of death were determined from the records of the patient's general practitioner. In those individuals where the general practitioner did not know the cause of death, a copy of the official death certificate was obtained.

The visual fields of each eye of those patients who were followed for 10 years were graded using the nine-stage severity scale proposed by Quigley *et al*.[9] The visual outcome was analysed at the 10-year follow-up visit. The probability of the visual field deterioration by one or more stages was plotted against time, using a Kaplan-Meier survival curve.

Additional statistical analysis was undertaken using a Student's t test comparing those that were followed for the entire period and those that died. Normality of data was assessed using the Kolmogorov-Smirnov z test. A finding was considered statistically significant if the p value was less than 0.05.

Results

Of the 57 patients, 17 died (29.8%) (8/27 males and 9/30 females) during the 10-year period. (Figure 1, Kaplan-Meier survival curve). Nine patients (15.78%) died because of vascular events; either cardiovascular (4), cerebrovascular (4) or complications of peripheral vascular disease (1). Other causes of death included infections (3), respiratory disease (2) malignancy (2) and suicide (1). The data analysed had a normal distribution in both groups. The mean (SD) age at presentation was 76.4 (9.7) years for those that died, compared with 69.5 (10.9) years for survivors (p = 0.029). There was no difference in the visual acuity (p = 0.85), visual field stage (p = 0.12) or IOP level (p = 0.40) on presentation, between those that were followed for the entire period and those that died.

The results of the 40 surviving patients were analysed. The mean (SD) IOP of this group on presentation was 25.6 mmHg (5.8) (right eye 25.8 mmHg, left eye 25.5 mmHg) and was 15.7 mmHg (3.0) (right eye 15.6 mmHg, left eye 15.9 mmHg) at the end of 10 years. The mean number of glaucoma medications used at 10 years was 1.28 (1.11) (range 1–3, median 1). Trabeculectomy was undertaken in 16 patients (10 bilateral; 26 eyes, 32.5%) and phacoemulsification with intraocular lens implantation in 12 patients (15 eyes, 18.8%).

Abbreviation: IOP, intraocular pressure

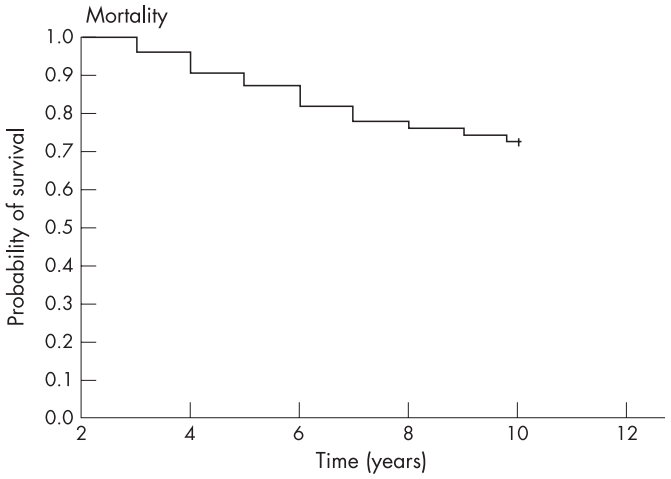

Figure 1 Kaplan-Meier survival curve: probability of survival.

The visual acuity at 10 years is shown in table 1 and the visual field results in table 2. On the basis of the visual field grading system, 42 eyes (52.5%) did not deteriorate over the period of 10 years, whereas 30 eyes (37.5%) deteriorated one stage, seven eyes (8.75%) two stages, and only one eye (1.25%) three stages. The mean time to first deterioration by one stage after initial diagnosis was 8.51 years (95% Confidence Interval = 7.92 and 9.10). The probability of the visual field deteriorating by at least one stage is shown in a Kaplan-Meier survival curve (figure 2). Ten patients deteriorated one stage in both eyes and one patient, who presented with advanced glaucoma in both eyes and during the course of his management refused glaucoma filtration surgery, deteriorated two stages in both eyes. In the patients with normal tension glaucoma, eight did not progress and three progressed one stage.

DISCUSSION

The average age on presentation of the patients in this study was 71.1 years. The life expectancy at 70 years of age in England is 13.2 years for males and 15.6 years for females (2003–2005).[8] There are no long-term population-based studies of life expectancy in patients with glaucoma. However, the average life expectancy of white patients with chronic open angle glaucoma has been calculated from cross-sectional analysis to be approximately 12.8 years.[9] The Blue Mountains Eye Study found an age-standardised all case mortality of 24.3% in persons with glaucoma and 23.8% in those without glaucoma nine years after initial evaluation.[10] In our study, 29.8% of our patients with glaucoma died within 10 years of diagnosis; most as a consequence of vascular disease. Diseases of the circulatory system are the major cause of death at 70 years of age in the UK.[11] The patients who died were significantly older on presentation than those who survived. Although it has been suggested that glaucoma is a ''sick eye in a sick body'' the question of whether patients with glaucoma are at greater risk of death than their peers has not been definitively answered.[12–14] Whereas Grodum *et al*[12] found that there was no difference in life expectancy between patients with glaucoma and controls, Lee *et al*[13] reported an increased risk of death from any cause and from cardiovascular disease in particular, in patients with glaucoma.

One of the problems of published studies on the long-term outcome of chronic glaucoma is that they are undertaken on patients who are recruited from the practices of glaucoma subspecialists whose patient profile tends to be skewed in the direction of ''difficult'' cases and include those with advanced disease.[6 14 15] This is not the case in our study where all the patients studied were referred by community optometrists to a hospital-based glaucoma case-finding clinic and few were lost to follow-up.

The rate of change of vision in glaucoma is often slow and consequently difficult to study. Clinical trials tend to use sensitive triggers to determine whether progression has occurred and selection bias may reduce the risk of progressive visual field loss in patients enrolled in longitudinal studies.[3 16] Our study shows that when a nine-stage severity scale is used, the rate of progression of chronic glaucoma is slow; it took an average period of 8.5 years to progress one of nine stages in our study compared to Eid *et al's*[15] study where it took on average 7.5 years to progress one of five stages. Because the various stages of progression are not ordinal, the Kaplan-Meier curve that was used to demonstrate progression over time should be interpreted with caution. Approximately one half (52.5%) of the eyes of survivors did not deteriorate by one stage during the 10-year period and approximately one third (37.5%) deteriorated by only one stage. Eid *et al*[15] found that 20% of eyes with chronic open angle glaucoma remained stable for 20 years and 43% deteriorated one of five stages. In our study most patients (85%) maintained good visual acuity (6/12 or better), although a fifth needed phacoemulsification with intraocular lens implantation to achieve this; a finding that has been previously reported.[3] Oliver *et al*[6] found that patients at greatest risk of blindness have moderate to advanced visual field loss at the time of diagnosis. Visual field progression of more than one stage in both eyes occurred in only one patient, who presented with advanced glaucoma.

Presumably, our favourable results are a consequence of achieving relatively low target pressures and good IOP control

Table 1 Visual acuity of survivors at presentation and at 10-year follow-up visit

Snellen visual acuity	Number of eyes			
	1994–1995		2005	
	%	n	%	n
6/6	48.75	39	33.75	27
6/9	35.00	28	37.50	30
6/12	7.50	6	17.50	14
6/18	3.75	3	6.25	5
6/24	1.25	1	1.25	1
6/36	2.50	2	2.50	2
6/60 or less	1.25	1	1.25	1

Table 2 Visual field staging at presentation and at 10-year follow-up visit

Staging of visual field	Number of eyes in each stage			
	1994–95		2005	
	%	n	%	n
Stage 1	40.00	32	17.50	14
Stage 2	21.25	17	30.00	24
Stage 3	13.75	11	17.50	14
Stage 4	8.75	7	16.25	13
Stage 5	8.75	7	5.00	4
Stage 6	3.75	3	7.50	6
Stage 7	3.75	3	5.00	4
Stage 8	0.00	0	1.25	1
Stage 9	0.00	0	0.00	0

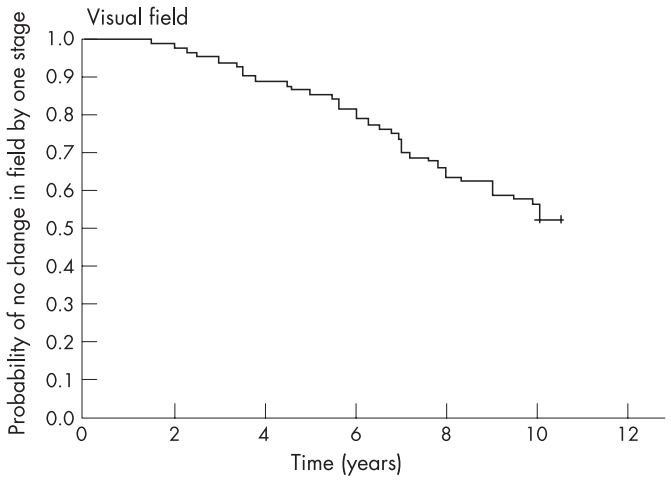

Figure 2 Probability of no change in the visual field by one stage.

during the period of follow-up (as shown at the 10-year follow-up visit when the average IOP was 15.6 mmHg). Most were managed with topical medication alone, although trabeculectomy was needed in 26 eyes of 16 patients. These results are consistent with the Collaborative Initial Treatment Study, that showed that therapy that is effective in lowering IOP would be expected to be beneficial.[3] The Advanced Glaucoma Intervention Study suggests that progressive glaucomatous visual loss is unlikely if all IOP measurements are maintained below 18 mmHg.[2]

It should be emphasised that our results are not applicable to all patients with chronic glaucoma as the patients in our study were white and presented with early glaucoma (61.5% grade 1 or 2). There is some evidence to suggest that if the diagnosis and treatment occur early in the course of the disease the visual outcome might be better than if there is established disease because the less damaged optic disc might be more resistant to further damage.[17] Our study is limited by the retrospective nature of the data and the non-standardised therapeutic regimens used (although all patients followed a stepped approach starting with medication and progressing to trabeculectomy). Nevertheless, the study gives an indication that if modern therapeutic approaches are adopted the rate of significant visual loss is likely to be slow. Similar patients to these can be reassured that with appropriate management the visual prognosis at 10 years is good.

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